5-1-2018

Educational Groupings In The Middle School Science Classroom

Erica L. McNeil
University of New England

EDUCATIONAL GROUPINGS IN THE MIDDLE SCHOOL SCIENCE CLASSROOM

By

Erica L. McNeil

BS Salve Regina University 2007

MAT Sacred Heart University 2008

A DISSERTATION

Presented to the Affiliated Faculty of

The College of Graduate and Professional Studies at the University of New England

Submitted in Partial Fulfillment of Requirements

For the degree of Doctor of Education

Portland & Biddeford, Maine

April, 2018

Erica McNeil
April 2018
Educational Leadership

EDUCATIONAL GROUPINGS IN THE MIDDLE SCHOOL SCIENCE CLASSROOM

ABSTRACT

Grouping students for learning has historically been debated among educational professionals. Twenty-first century skills encourage students to work together within their classrooms in preparation for future careers. Adopting Next Generation Science Standards (NGSS) has required educators to encourage collaboration among students for science learning. Understanding the implications of student groupings and differentiated instructional strategies on learning requires an important conversation for educators who strive to support all learners needs sufficiently and prepare them for their future. This qualitative study examines and describes the perceptions of teachers regarding the role of educational student groupings on student learning of science concepts. Ten middle school science teachers participated in one-to-one interviews to gather data. Results indicate teachers group students with a purpose to collectively learn in a collaborative environment as well as a way to maximum their time and resources. Grouping was found to be most efficient when students were working together cooperatively as engaged participants, free from behavioral distractions and supported with special education staff when needed. NGSS influenced classroom instruction by aligning curricular standards and introducing a high level of inquiry, collaboration and twenty-first century skills. These findings support the need for educational grouping professional development for science teachers to strengthen their understanding and practice within the classroom. This study's findings informs teachers and school leaders as they strive to respond to

requirements for educational groupings outlined by Next Generation Science Standards and 21st century skills.

University of New England

Doctor of Education
Educational Leadership

This dissertation was presented
by

Erica McNeil

It was presented on
March 26, 2018
and approved by:

Michelle Collay, Ph.D. Lead Advisor

University of New England

Andrew Ross, Ph.D. Secondary Advisor

University of New England

Christopher Clouet, Ph.D. Affiliated Committee Member

Shelton Public School System

ACKNOWLEDGEMENTS

I would like to acknowledge and thank Dr. Michelle Collay, lead advisor of my dissertation committee, for her patience, support and guidance throughout this research process. I admire the time and effort it took for Dr. Collay to help me expand my thinking and inspire new learning as my research and dissertation progressed. As a result of her guidance, I have grown as an educator and student. I would also like to extend my appreciation to my second advisor, Dr. Andrew Ross and my Affiliate Committee Member, Dr. Christopher Clouet. Thank you for your honest feedback and for pushing me to think "outside of the box."

I am proud to work at the middle school that was the site for my study. It is my professional home and the colleagues there are family. Thank you for all of the well wishes and support. To the study participants: thank you for your honest account of your educational experience. Each of your interviews revealed your passion for teaching and love for your students.

Thank you to my family and friends for your constant love and encouragement as I achieved this academic dream. Thank you to all four of my grandparents for always being present and cheering me on throughout each step of my education. To my brother—thank you for keeping me humble and bringing me back to reality when I needed it the most. To my Oliver—thank you for the countless hours spent as my companion and typing buddy throughout this process.

To my husband—I cannot begin to thank you enough for being my rock. I can always count on you to encourage, listen, keep me laughing, and remain patient. You are a perfect match for me, and I am so lucky to have you by my side forever.

Most importantly, I want to thank my parents for always accepting me and standing beside me; this doctorate is as much theirs as it is mine. To my dad—since I have been a little girl you have given me the confidence to achieve any dream. Thank you for the self-reliant attitude and instilling a drive in me to always work hard and want the best. To my mom—thank you for your willingness to never give up on me, to encourage me to pursue the highest degree I possibly could and pushing me to always stay strong. Your strength and encouragement is the reason for my academic accomplishments, specifically this dissertation.

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

One of the most difficult challenges facing teachers today is the wide ability range of the students they teach. "How to group students to ensure an optimal learning environment for productive student questioning is an area to be explored" (Kaya, 2015, p. 432). Understanding the implications of student groupings and differentiated instructional strategies on learning requires an important conversation for educators who strive to support all learners needs sufficiently and prepare them for their future careers. Sparks (2012) reveals that the modern workplace demands that students develop cognitive, personal, and interpersonal abilities. As a result, teachers are faced with the dilemma of creating lessons that engage learners on a deeper level and use strategies that support student-centered learning.

This is especially true of science education where, the Next Generation Science Standards (NGSS) instructional model encourages student groupings during science unit learning activities. According to Penul (2015), NGSS present an unprecedented opportunity to transform science education for all students in every community across the United States. NGSS largely relies on problem based learning in a grouped setting. Using these standards can help to create a 'real world' connection in science classrooms across the nation preparing science students with an array of 21st century skills needed for success beyond the classroom.

During my own educational journey as a teacher, I have seen a transformation in public school science classrooms. Over the past generation, teachers often organized students homogenously based on standardized test scores or intellectual ability (Karlson, 2015; Klapproth, 2015; Vogl & Preckel, 2014). More recently, science teachers have begun to heterogeneously group students to organize learners for a differentiated approach (Kapusnick &

Hauslein, 2001; Tobin & Tippett, 2013). Some of the factors that have led to heterogeneous student groupings include equity of education and differentiation across ability levels. Students have unique interests and abilities upon which they draw for learning and the need for educational groupings within a heterogeneous classroom is necessary to foster learning (Worthy 2010).

Over the course of ten years in my own school setting I observed teacher training professional development designed to encourage the implementation of several different teaching strategies, all claiming to be most effective for learning science concepts. Diverse types of groupings suggest students can be configured several ways for collaborative instruction including heterogeneous, homogenous, problem-based, gifted and multiple intelligences. The perception of effective educational grouping can differ based on personal preference and experience. Teacher beliefs play a central role in planning classroom instruction (Cate, Schwerdt, & Glock, 2016). For example, decisions about how to group students for science are based on teacher beliefs, curriculum structures, assessments and small grouping measures such as multiple intelligence inventories. Teacher perception plays a large role in determining the type of strategy used to effectively group students to excel during classroom tasks and assessment (Watanabe, Nunes, Mebane, Scalise, & Claesgens, 2007).

Problem Statement

Teachers' ideas about grouping students for instruction play an important role in their decision-making. Unexamined beliefs about grouping may influence their practice and prevent them from engaging in innovative instructional approaches that require different kinds of groupings. A major revision of educational strategies to improve science education has become the main focus in classrooms across the United States as Next Generation Science Standards are

adopted throughout public education (Stroupe, 2015). These recent shifts in science education have promoted problem-based grouping for individualized learning.

> The skills considered necessary for the 21st century workplace generally fall into three categories: cognitive, such as critical thinking and annalistic reasoning to learn "deeply"; interpersonal, such as teamwork and complex communication; intrapersonal, such as resiliency and conscientiousness. Research suggests that students need these skills to be successfully hired in the workplace. (Sparks, 2012, p. 7)

The introduction of the Next Generation Science Standards teaching methods, problem-based learning and differentiated strategies in heterogeneously grouped classes has raised concerns. Professional development directed specifically on grouping strategies for NGSS may alleviate the concerns raised by teachers, students and parents about ability grouping in the general classroom (Worthy, 2010).

However, there will not be irrefutable evidence for any type of instruction or grouping strategies for students to learn science. Research about the influence on group configurations to improved student learning is inconclusive (Hornby, Witte, & Mitchell, 2011). Consequently, teachers and students have their own perspectives and opinions on the effectiveness of different configurations of grouping practices in the classroom based on their own thoughts or experiences throughout their own educational journey. Opinion differences about educational grouping may contribute to a lack of cohesive learning for students. With changing expectations and a greater focus on 21st Century skills, students may not always be grouped effectively to meet all learning needs.

Purpose of Study

The purpose of this qualitative, phenomenological study was to examine and describe the perceptions of teachers regarding the role of educational student groupings on student learning of science concepts. Their beliefs about the benefits and challenges of using groups for teaching and learning in a Northeastern middle school science classroom were documented. Teaching and learning perspectives and beliefs about how people learn may influence the effectiveness of student grouping in the classroom. Participants of the study were currently employed in a public school working with student groups enrolled in seventh and eighth grades.

Research Questions

This qualitative study addressed this general question: What are teachers' perceptions of the purpose groups serve during science instruction?

More specifically:

(a) What is the purpose of student grouping during science instruction?

(b) What groupings do teachers perceive as most effective for science instruction?

(c) How do teacher perspectives on NGSS science learning influence their grouping practices?

These findings can be used to inform the educational community and guide future middle school science teachers in their decision-making about student groupings.

Conceptual Framework

The concepts that inform current thinking about educational groupings in classrooms are grounded in learning theory. Constructivist learning theory suggests that learning is based on the individual and the experiences each student has during the process of learning, placing importance on the learners' point of view. "Teachers who use a constructivist model of learning

theory attend to the need to have students interacting in positive ways with others and actively engaging, at their own pace, in the process of knowledge construction" (Coupal, 2004, p. 590). As students work in a positive way together, it is important that they also relate their learning to real world scenarios and tasks. Zane (2009) explains that learning should be integrated into real-world tasks rather than presenting a curriculum with consecutive tasks where topics are covered by the teacher unrelated to previous knowledge or learning.

> Vygotsky's theory of the zone of proximal development says that learners can acquire knowledge more rapidly when working with others more expert in a given task. His theory acknowledges that learners are transformed by their transactions with social and physical environments. (Lippman, 2015, p. 40)

Student groupings are largely based on the collaboration of students working together to acquire knowledge. Therefore, Vygotsky's theory may help to explain and describe educational groupings in the context of collaboration and student perspective.

Gardner's (2011) theory of multiple of intelligences is highly regarded in some educational circles and describes many types of learners and individual learning modes used by different students. Multiple intelligence theory is commonly used to inform grouping strategies. This theory drives instruction and informs approaches to organizing learners. McFarland (2011) explains that it is assumed by some in the educational community that multiple intelligence theory is the most effective platform for instructional methods in the 21st century.

Research has shown that cooperative learning promotes interaction and communication among group members and enhances engagement in the learning process (Jurkowski & Hanze, 2015). Implementation of cooperative learning strategies can be found in several educational grouping methods. According to Sencibaugh (2016), cooperative learning is an instructional

method, or peer-assisted learning strategy where students work together in small groups to help each other learn. Cooperative learning benefits students in that they can positively work together to help each other learn and boost academic achievement in a group setting (Foldnes, 2016). However, cooperative learning can be challenging for some student groups. For cooperative learning to yield benefits, all students must be engaged in learning collaboratively, working together towards a common goal (Jurkowski & Hanze, 2015). Decision making about how to group students is complex and teachers need to understand the purpose of educational grouping practices in the science classroom before they can fully embrace new standards.

Teacher decision-making about effective use of student groups does not occur in a vacuum. Mandates to teach 21st Century skills, district curriculum NGSS adoption, and curriculum structures all influence teachers' decisions about organizing for learning. Science instructional goals reach beyond students learning memorized terms, rather, cooperative problem based learning skills are instilled throughout the curriculum. Educators are challenged to meet each student's individualized needs. The NGSS curriculum brings about the need for a wide array of teaching strategies and skills based solely on collaborative, project-based learning goals. Harmer & Stokes (2016) emphasize that project-based learning is based on the assumption that people learn best through doing and that learning is more effective when related to the exploration (and/or solution of) real-world problems. Grouping students thoughtfully is important when teaching using a problem-based approach as well as NGSS student-centered standards. Hall and Miro (2016) explain the importance of student centered instruction and group work, which must be accompanied by teachers coaching other teachers help to cohesively develop student understanding of the science curriculum. Therefore, addressing and supporting the individual needs of each student, while challenging, will contribute to improved science

education and prepare students for their future. Grouping strategies organize students effectively to meet learning goals.

Assumptions, Limitations and Scope

In this study the assumptions about research on educational groupings were based on the research that suggests learners can acquire knowledge more rapidly when working with others more expert in a given task. The focus of the study is documenting the beliefs of public middle school teachers who are tasked to implement teaching and learning approaches to science about the purpose for grouping students.

Findings of the study were limited to one site, a middle school level of seventh and eighth grade students. Limitations include the limited pool of participants as well as the location and suburban setting of a public middle school. As a colleague and participant of the school community, I remained attentive to my opinions and biases during data collection. In an effort to address my biases, validity fact checks were conducted. While these limitations are present, it cannot be assumed that findings will be generalized to all science classrooms. The findings reflect the experiences of this population of middle school teachers.

Rationale and Significance

Current research (Francis et al., 2017; Edwards & Edwards, 2017; Leshkovska & Spaseva, 2016; Kim, 2012; Rowcliffe, 2006) presents conflicting findings on the effectiveness of different educational grouping methods, indicating a need for further study. By documenting teachers' perspectives about the most effective approaches to determining classroom groupings for science, this study contributes to research regarding science instruction. Specifically, teachers gained information on the role of educational groupings in response to implementing

Next Generation Science Standards and 21st Century classroom skills in the middle school science classroom.

The results of this study will further research by providing teachers' perspectives on the purposes and effectiveness of grouping students for science learning. Teachers who participated in this study might apply the findings to public middle school science classrooms. By examining teacher perspectives surrounding educational groupings I have gained a deeper understanding of teacher perception regarding educational groupings. As well, the study has documented strategies to help teachers to balance factors in their decision-making when creating educational groupings to meet individual student needs in a middle school science classroom.

Definition of Terms

For the purpose of this study the following terms are defined.

Educational Grouping: a group of students that are specifically assembled together to enhance the educational experience in a purposeful way.

Next Generation Science Standards (NGSS): Educational science standards focused on participation in science practices. Provides students with the opportunity to engage in authentic science work.

21st Century Skills: Educational as well as social-emotional skills taught in school that include but are not limited to: creativity interdependence, self-confidence, self-efficacy, teamwork, communication, complex thinking, empathy, knowledge on searching and managing, research methodology, presentation and discussion skills, digital skills (using internet tools), punctuality, reliability, and patience (Aslan, 2015).

Student Group: a group of seventh and eighth grade students from a Connecticut public school.

Public School: a school located in southern Connecticut that receives public funds and follows guidelines from state and federal educational laws.

Heterogeneous: the placement of students of different abilities in one classroom.

Homogeneous: the placement of students of similar abilities in one classroom.

Tracking: Students groups based on academic ability levels

Conclusion

The purpose of this study was to document teacher perceptions regarding the purpose of and effectiveness of student educational groupings in middle school science classrooms. The findings of the study inform teachers and school leaders as they strive to respond to requirements for educational groupings outlined by Next Generation Science Standards and 21st century skills. The literature review outlines the existing research that determines educational groupings, and the theories that support the use of learning groups in classroom instruction. Chapter three describes the methodology used in the study and explains how data was collected for a qualitative review. Chapter 4 presents the data that was collected and analyzed. Chapter 5 concludes the study with an explanation of the findings and recommendations from this study.

CHAPTER TWO

REVIEW OF THE LITERATURE

In the very beginning of American public education, many rural schoolhouses were typically one room and housed many different grade levels and a single teacher. Today's educational structure is vastly different. Public school educators in the United States are experiencing increasingly diverse student populations and encountering intensified federal accountability for student academic achievement (Brooks & Thurston, 2010). Instructional approaches increasingly moved toward direct instruction of different disciplines for age-alike students. "Beginning in the 1980s, educational reform in the United States has largely been focused around standards as a means to leverage equity and excellence for all. By the mid-1990s, standards were the rallying point for educational reforms in school districts across the nation" (Abu El-Has & Rubin, 2009, p. 447). The purpose of this literature review is to provide a foundation for the use of methods that are currently being used to group students for science education. The topics that are addressed are: the purposes of grouping students for learning; the historical evolution of grouping students in North American schools; common grouping methods; theories that inform grouping practices; the role of assessment in grouping decisions and limitations regarding educational grouping as an instructional strategy

Purposes of Student Grouping

Progressive educators have always believed that learners co-construct knowledge through interactions with teachers and each other. As a result, student grouping grew as an essential approach to providing constructive learning opportunities that use multiple strategies to engage student learning. Practitioners and researchers have long debated the merits of different types of groupings as a way to organize students for learning. While some educational

professionals may advocate for one best student grouping method that would effectively assist educators to achieve all goals, no definitive grouping style can be found to reign supreme. As a result, whether and how to structure educational groups continues to be a widely debated issue (Gray, Kruse, & Tarter, 2016).

At the national level there has been a revision of science standards and educational strategies. Differentiation of instruction and configuration of students through groupings have become a main focus in classrooms across the United States as Next Generation Science Standards are adopted throughout public education (Stroupe, 2015). Science education standards promote problem-based learning in groups for daily classroom instructional practices (Penuel, Harris, & Haydel, 2015). Teacher evaluation has a strong focus on attending to student learning outcomes and is measured on some degree on the quality of instruction students are provided. Recently, teachers evaluations include how instruction is grouped and organized. Gagnon and Collay (2001) clarify that this process can be deceptively simple and exceedingly challenging. Grouping students effectively has become a necessity as newly adopted teacher evaluations create a need for differentiated groupings as a common practice in science classrooms. Teaching strategies are geared towards instruction while holding students accountable for their own learning. As a result, decisions about grouping methods are a significant aspect of planning, teaching and learning. This review encompasses literature that depicts the past ten years of research about grouping methods and limitations, and theories behind the methods used for groupings.

Grouping Methods

Documentation of grouping methods in American education began at the turn of the 20th century when schools were flooded with immigrant children. The belief that some social classes

were superior to others led to a tracking system in the United States (Broussard, 1998; Ansalone, 2010; Hu, Makel, & Kubilius, 2016). Currently educational groupings exist as a way to combine students into classrooms to maximize learning efficiency. Business firms already have moved towards encouraging employees to work in teams; educational institutions accordingly need to adapt cooperative learning methods to help prepare students for the workplace (Kapusnick & Hauslein, 2001; Tlhoaele, Suhre, & Hofman, 2016). Different grouping strategies exist to purposefully group students for learning efficiency. However, combinations of how and why students are grouped may depend on several different factors and practices.

Tracking

Tracking students by ability for the purposes of improving learning is fraught with many assumptions about how learning takes place, and is often based on educational biases. Teachers' biases about learners may occur when tracking students based on teachers' assumptions about students' intellectual ability. Macqueen (2013) suggests that there is a lack of equity in tracking among educational philosophies. He indicates that tracking produces uneven academic outcomes, discriminates against social development among students, and leads to negative effects on teaching practices. Tracking based on letter grades from early in the term, and teacher-made or standardized assessments may lead to inequitable sorting practices of students beginning in the primary grades. Tracking practices are challenged at the high school level more often because of the wide use of ability grouping for high school core subject classes. Practices of tracking based on teacher opinion exist, yet, some research has challenged its use (Cate, Schwerdt, & Glock, 2016; Karlson, 2015; Klapproth, 2015). It can be argued that organizing students into appropriate learning settings can be improved using new technologically advanced measures to eliminate biases (Klapproth, 2015).

Educational practices in several countries, including the United States, typically base student grouping in secondary school classes on perceived intellectual ability. Tracking based on teacher opinion is called "critical judgment." For example, students are tracked based on a teacher's opinion using measures such as standardized tests, behavior and classroom grades. When an algorithm is used to create groups it is called "mechanical judgement." Klapproth (2015) finds using algorithm to group students effectively eliminates any biases, however, critical judgment is most often used, creating bias limitations to educational groupings. Hornby, Witte, and Mitchell (2011) found that school management often dictates grouping practices. Principals reported positive and negative aspects of ability grouping citing specifically the benefits of mixed ability grouping positively affecting special education students. Students have reported being confused by tracking decisions and argued that standardized test scores were an inaccurate way to measure ability level. "Perhaps most interesting was that many of the students, regardless of track level, believed their classes needed to be more rigorous" (p. 20). Likewise, Hornby et al. (2011) suggests that tracking is not an effective strategy for facilitating the optimum academic achievement. Tracking practices exist as a method to group students, although this practice may be controversial, it is still widely practiced in many classrooms.

Ability Grouping (homogenous)

Kim (2012) defines ability grouping as a practice that places students into classrooms or small groups based on an initial assessment of their readiness or ability. Ability grouping has received considerable attention in educational research in many countries over past decades. Hornby et al. (2011) state that "The central argument behind ability grouping is that homogeneous classrooms permit a focused curriculum and appropriately paced instruction that leads to the maximum learning by all students" (p. 92). They further explain that ability

grouping allows teachers to highlight minor ability differences between pupils and challenge the students accordingly. Ability grouping advocates assume the process allows students to be placed with like thinkers and learners. In many cases, grouping students by ability will allow for differentiated accelerated goals, broadening and extending beyond the curriculum for high-level learners (Missett, Brunner, Callahan, Moon, & Azano, 2014).

However, Hallam and Ireson (2007) explain that there is significant evidence from evaluation of learning in tracked ability level classes with evidence that "lower ability level students" are the most affected by a negative stigma over the long term. As a result of placement in the tracked classes, students who score lower on standardized tests (they don't necessarily have lower ability levels) perceive a level of academic inaccuracy among intelligence and work set. Students are more likely to have lower expectations of themselves academically if tracked in a lower level class (Karlson, 2015). Grouping students homogeneously has been shown to benefit some and hinder the education of other students depending on what level of track they are placed.

> Critics and opponents cite ability grouping as a contributor to achievement gaps, the stratification of educational opportunities, and detrimental psychosocial outcomes, such as lowered self-concept or self-esteem, particularly for disadvantaged or lower achieving students (Hu, Makel, & Kubilius, 2016, p. 852).

There is a negative impact on social and personal outcomes for students placed in lower tracks including deterioration of their educational progress. Homogenously tracked classes offer limited flexibility among teaching practices and present difficulties for students wishing to move to a higher track. This practice may keep a student "locked in" to a particular educational group (Hallam & Ireson, 2007). Ability grouping highlights key differences between leaners and

challenges students according to ability level. While homogenously tracked grouping could benefit as well as hinder student education opportunities, the negative outcomes must be kept in mind by teachers who seek to utilize appropriate instructional strategies.

Gifted and Talented Student Tracking

Research on providing gifted students appropriate instruction is conflicted. Some researchers believe gifted students thrive when they can lead peers, while others report findings that support like-minded learners work best together. Despite the conflicting findings about student placement, all learners should be exposed to curriculum that challenges their unique abilities as well as enriches their personal learning. The unique traits of gifted students call for educational programming commensurate with students' ability and needs (Young & Balli, 2014, p. 237).

This statement is true for all learners: Gifted students require academic challenges and an environment that fosters goal-oriented learning. Gifted and talented students are often grouped with students of the same intellectual ability and talents as well as because they are perceived as more goal orientated. Benefits of gifted tracking are well documented, yet, this form of grouping is still otherwise debated when the social-emotional status of gifted students in tracked classes is considered (Vogl & Preckel, 2014).

Preckel and Brull (2008) discuss The Big Fish Little Pond Effect (BFLP) on Self-Concept and found that gifted students thrive when in a group where they are the "big fish" rather than when they are grouped with like-ability students. The gifted students tend to put academic pressure on themselves in these same ability groupings and anxieties resulting from these self-inflicted pressures occur. Vogl and Preckel (2014) were also concerned with the well-being of gifted students when grouped with other students with similar standardized test scores.

They focused on comparing a gifted group of high ability students to a regular group of students that were heterogeneously grouped, but shared the same balance of gender, social economic status and cognitive ability. Students were engaged in a classroom and learning the same material, but the material was differentiated to their learning style. Cognitive ability did not have an effect on the findings. Students that were grouped by gifted status did show an increase in peer and student relationships. Gifted students were more engaged; nevertheless, grouping by ability did not prove to have any effect on social self-concept. Vogl and Preckel (2014) conveyed the fact that grouping gifted students is beneficial to the peer relationships because at times gifted students can feel lonely.

Students who are labeled gifted may receive enriched learning different from their regular education peers. Gifted education may increase student engagement as well as challenge student learning at suitable learning levels. However, students may feel isolated and increased academic pressure to perform at a higher level of academic rigor.

Mixed Ability (Heterogeneous) Grouping

Mixed ability classrooms allow for differentiated instructional strategies to be embedded into the curriculum. A mixed ability grouping method encourages multidimensional classrooms, valued student differences, and encourages student responsibility. Learning for all students can be supported individually when grouping is heterogeneous.

> In addition, many classrooms today include students who have a wide range of previous academic achievement and different levels of oral and written proficiency in the language of instruction. Such classrooms pose considerable pedagogical challenges for teachers and administrators who aim to support the learning of all their students. (Lotan, 2009, p. 32).

According to Boaler (2006) as a result of heterogeneous groupings, students achieved more equitable outcomes on tests, and learned to act in more equitable in their classrooms. Over time students will learn to appreciate the contributions of their peers in a heterogeneously grouped classroom (Lotan, 2009).

On the contrary, Rowcliffe (2006) presents a review of current research regarding ability grouping practices. It is reported that mixed ability classes are holding back the educational potential of higher-ability students; he further explains that students are often grouped based on inappropriate measures or behavioral reasons. Rowcliffe proceeds to explain that students can become 'stuck' in a track unable to move. He clarifies that high numbers of students are placed in the wrong settings and are then unable to move due to curriculum and organizational factors. Ability labels associated with both high- and low performance designation can result in the stigmatization of students, and their self-concept is damaged (p. 92).

Mixed-ability classrooms are prevalent in many schools across the United States. A collaborative working environment is supported by teachers with the use of heterogeneously grouped classes as well as equity in the classroom. Differentiated instructional methods support learning goals in mixed ability classrooms despite the pedagogical challenges teachers face concerning heterogeneous grouping.

Standards-based Grouping

Grouping using evidence-based standards for assessment of student knowledge rather than teacher decisions about grouping must also consider many factors. Vogel (2012) found challenges of implementing a standards-based grouping approach to an entire school system grades kindergarten through twelfth grade. Upon the adoption of common core standards, the district leaders decided to change their norm-referenced assessments grouping system to one

using standards-based assessments. The district leaders believed that students learn at their own pace and they should not be forced to learn at a pace not suited for the individual student. The administrators believed that grouping by students' demonstration of meeting standards would support their learning needs more effectively. Overall, standards-based grouping places importance on mastery of content rather than social promotion from grade level to grade level without mastery of content.

Vogel (2012) found that standards-based assessment grouping can be used to strengthen student performance; however, planning for implementation is essential. Without proper preparation for implementation the standards-based grouping strategy will not be successful despite how wonderful the program proves to be. Standards-based grouping is an approach to instruction teaching strategy that is less familiar and could receive pushback from stakeholders. As a result of these challenges, standards-based groups are not widely used in education. Preparation is essential for successfully implementing any grouping strategy. Professional development and resources as well as full knowledge about the approach by all stakeholders is an essential part of any successful student grouping initiative.

Multiple Intelligence Theory

Gardner's (2011) theory of multiple of intelligences is highly regarded by some educators and consists of many facets that allow recognition of individual abilities according to the learning modes of the student. Multiple intelligence theory is used by some teachers to inform grouping strategies and the theory drives instruction as well as methodology. Some research about individualized learning suggests that each student has their own effective way to learn and those approaches fall into a specific intelligence category (McFarlane, 2011).

> Recognizing that each individual serves a purpose and that the classroom and school of the 21st century are "diversity mirrors" of our world, then it becomes only logical that there is need for a broader conceptual framework for teaching and learning. (McFarlane, 2011, p. 7)

It is assumed by some in the educational community that multiple intelligence theory provides a lens for planning instruction. Gardner (2011) proposed that all humans have multiple intelligences. Some "intelligences" may be stronger than others depending on the individual. These intelligences include: linguistic, logical-mathematical, spatial, musical, interpersonal, intrapersonal, kinesthetic, and naturalist. Gardner's (2011) work is regarded as a main source of differentiated instructional strategies throughout education over the past thirty years. Hyland (2011) explains that a focus on differentiated instructional methods as well as collaborative work is essential to understanding ability grouping and reform. The theory of Multiple Intelligences provides teachers with one approach to developing grouping criteria (McFarlane, 2011). Recognition of Multiple Intelligences can inform teaching strategies that address a diverse audience to benefit a global society of people across the multiple intelligence scale.

However, it is important to note there are diverse beliefs and benefits about the practice of differentiated instruction (Tobin & Tippett, 2013). Some teachers believe that differentiated instruction is just another way to homogenously group students into a tracked system of learning opportunities. Consequently, differentiated instruction can be used to "pigeon-hole" students and may lower their self-esteem (Pennington, 2010). To ensure differentiated instructional groupings do not inadvertently lead to homogenously grouping students, teachers should design lessons to develop higher order thinking for all students (Leshkovska & Spaseva, 2016). Tobin & Tippett (2013) discuss the potential barriers and the possibilities for teachers planning for

differentiated instructional lessons in their science classrooms. Their research captures the struggle that teachers face providing instruction to several different types of learners within the same classroom and conclude that differentiated instruction is an effective way to change modes of teaching to include a new way of thinking about curriculum and instruction.

Problem-Based Learning

According to Pepper (2010), structuring problem-based learning activities is a teaching strategy where lessons are designed with a problem at the center, and represent authentic, real-world situations which small groups of students work to resolve. These problem-focused learning groups help to promote interaction among peers and community building. He further explains students enjoyed interacting with peers and the discussions that occurred within the problem-based learning groups. Students expressed increased learning satisfaction in this type of classroom learning environment. "Project-based learning rests broadly on the belief that people learn best through doing and that learning is more effective when related to the exploration (and/or solution of) real-world problems" (Harmer & Stokes, 2016, p. 532). Hall and Miro (2016), found that problem-based learning promotes higher-level instructional feedback, higher-level questioning strategies, integration of subject areas, student discussion, and student self-assessment. "Some of the distinct features of a PBL curriculum include student-centered instruction, teachers acting as coaches; students responding to a driving question, development of investigation and/or artifacts, collaboration, and the use of technology" (p. 310).

Although some research suggests problem-based learning groups are an effective instructional grouping method, Gulpinar, Isoglu-Alkac, and Yegen (2015) report problems students faced during the group learning process. Some learners may not feel successful in group settings and methods that individualize instruction may be needed at some points in the

science classroom. “These problems include poor group dynamics with superficial interaction and unsatisfactory student participation, inefficient group productivity, lack of integration, and lack of deep knowledge processing” (Gulpinar, Alkac, & Yegen, 2015, p. 1224). Problem-based grouping is one instructional approach to group students together to solve a multi-step problem. In theory, the future of education will likely be geared towards this approach to educational grouping because of the need to support development of 21st century skills required to function in the modern workplace (Sparks, 2012).

Student Grouping Research Limitations

The current grouping debate is fueled by a mixture of research that demonstrates conflicting evidence about the effect of grouping practices in education (Kaya, 2015). Current research about grouping doesn’t fully examine gender bias, social bias and academic inconsistences. Research on group configurations and how they may reinforce stereotypes is limited and there is a need to continue the examination of educational grouping methods. Grouping students requires careful formation to ensure a balanced combination of students to cooperatively work together to facilitate learning (Jurkowski & Hanze, 2015).

Role of Assessment

Formative assessment was historically used to quickly identify students’ academic potential and create a measure of intelligence that informed decisions about placement. These measures lead to labels for student groupings, and as a result a label of identity of individualized students (Missett, Brunner, Callahan, Moon, & Azano, 2014). Missett et al. (2014) indicate that ability grouping based on formative assessment scores is a ‘one size fits all’ method of educational grouping. They voice serious concerns regarding the emotional impact ability grouping using formative assessment may have on students has created a stigma against using

these methods in classrooms. Ansalone (2010) challenged assumptions about tracking children in school based on standardized test scores and concludes that tracking can be based on defective measures and promote a learning environment that restricts learning based on assessment scores.

In accordance with the adoption of the Next Generation Science Standards, the Northwest Evaluation Association has aligned an adaptive test to be administered as a science education assessment (Bolkan, 2016). This standardized test assesses students based on NGSS standards and is intended to inform instructional practice based on growth throughout the academic year (Kloser, Borko, Martinez, Stecher, & Luskin, 2016). Ambitious science education goals aligned with standards and assessment have highlighted the importance of understanding effective instructional practices for educational groups.

The Influence of Reform on Teacher Decision-Making about Instruction

Expectations that contemporary curriculums support development of 21st century skills require teachers to respond to pressures to align instructional methods with those outcomes (Aslan, 2015). Teacher perceptions are the most powerful influence on classroom instruction. However, some teachers may be reluctant to respond to these changes because of their personal beliefs about the educational system reforms. Bower and Parsons (2016) report that teachers' personal experiences outside the classroom greatly impacted their instructional practices. They also explain that teachers find it hard to create an identity for themselves in the classroom because of outside influences affecting their own thoughts and beliefs on education. "Individual teachers found it challenging to define their identities because of conflicting views of them: the public's, invested stakeholders', and their own beliefs about teaching and learning" (Bower & Parsons, 2016, p. 745). In an era of constant reform and educational restructuring it is important for teachers to have a solid foundation of their own identity within the classroom. "Teachers

develop a professional identity as they learn a multitude of skills, gain a breadth of knowledge and move from novice to experienced practitioners, and this journey is a complex and idiosyncratic one" (Edwards & Edwards, 2017, p. 191).

Grouping students effectively can be a puzzling process for teachers to accomplish as a response to new curriculum or science standards. "Even before teachers decided how to group students, adapt content, or adjust their presentations, district and school policies set the conditions for teachers' decisions" (Park, 2017, p. 280). As a result, teachers are influenced by their beliefs about how students learn, challenged by how to assess individual students within a group setting, and pressured by mandates and reform to change how they teach.

Teacher Stressors

The teaching profession has grown to become more and more demanding. Rising pressures to perform under unruly circumstances such as budget cuts, lack of support and continually developing curricular standards has effected teacher well-being and stability. "Living in an unstable, uncertain and ever-changing world many teachers are worried" (Albu, 2012, p. 60). Teachers are likely to have different needs depending on the amount of teaching experience they have gained. Despite the differences in their professional preparation and skill, teachers are continually expected to take on a large workload in complex circumstances:

> Teaching is a highly demanding profession, often characterized by an excessive workload, the failure of pupils to work or behave properly, poor relationships with colleagues, lack of suitable resources, constant changes within the profession and difficult interactions with the parents of students (Guglielmi, Bruni, Simbula, Fraccaroli, & DePolo, 2015, p. 324).

In a study of teachers nationwide, Richards (2012) reported that two of the top five causes of stress among teachers were teaching at-risk students without enough support and accountability measures imposed by state standards. With constant pressure to produce high assessment scores, demands on teachers outweigh teacher support and workload (Gonzalez, Peters, Orange, & Grigsby, 2017). Stress from the pressures of teaching can affect the learning of students, especially when a lack of support and time needed for learning is interrupted by standardized testing. "Teachers who experience high levels of stress and frustration may transmit these feelings and their impacts directly to students via 'stress-contagion'" (Jennings, 2017, p. 1011).

There are many studies that address teacher burnout and high levels of attrition that may be attributed to the pressures reviewed here. "Lack of support and guidance by coordinators and administration in classroom management, lesson planning, and teaching content can lead to burnout" (Helou, Nabhani, & Bahous, 2016, p. 565). Burnout may be experienced at any point in a teacher career due to circumstances stated. "Policymakers and educators must realize that good teachers can succumb to burnout and work actively to demonstrate that concern" (Richards, 2012, p. 312). Teacher stress is the collective responsibility of teachers, principals, training programs, and superintendents, and the educators themselves who continually ignore their own well-being (Prilleltensky, Neff, & Bessell, 2016). Providing teachers with adequate professional development and resources needed for proper preparation in the classroom may help to alleviate common stressors that contribute to teacher burnout.

Theoretical Framework

Educational groupings potentially benefit an individual and contribute to a community growth mindset. Grouping plays a role in the learning of students because students must learn to cooperate in a heterogeneous grouping as well as maintain focus homogenously surrounded by like-minded thinkers. "This aspect of education acknowledges the human interaction involved in communicating, relating and learning" (Gagnon & Collay, 2001, p. 50). Teacher perceptions are based on their knowledge of instructional grouping strategies for differentiated learning. Decisions about groupings may affect students' opportunities to learn.

According to Sencibaugh (2016), cooperative learning is an instructional method, or peer-assisted learning strategy where students work together in small groups to help each other learn. This approach indicates an educational grouping practice for teachers in the science classroom. Research has shown that cooperative learning promotes interaction and communication among group members and enhances engagement in the learning process (Jurkowski & Hanze, 2015). Implementation of cooperative learning can be found in several educational grouping methods. Jurkowski and Hanze (2015), found that cooperative learning grouping methods increase understanding of material and are effective to the learning process as compared to individualized learning because of the thought provoking questions asked through peer to peer questioning. Cooperative learning as a central element of and purpose for educational grouping may effectively help students learn on a higher level.

Classrooms need to evolve to respond to a rapidly changing society. Mandated curricular alignment with 21st century skills are necessary and should be taught in every American classroom, and it is up to teachers to reshape instruction to fit these mandates (Lee, Miller, & Januszyk, 2014). Next Generation Science Standards (NGSS) offer a comprehensive framework of science teaching standards that incorporates student groupings as well as rigorous curricular

designed for students to practice inquiry in the 21st century (Larson & Miller, 2012). In a middle school science classroom individual classroom level decisions about grouped lessons are often made at the teacher's discretion. However, the extent to which teachers are able to accurately identify students for orientation towards different educational groupings is not only important for the student's direct educational pathway but may also have a long-lasting effect on the student as a learner (Pit-ten Cate, Schwerd, & Glock, 2016).

Conclusion

Educational tracking and grouping methods are topics that have been debated for decades. There are studies that address both sides to the argument for and against the use of tracking in a school system. Overall, teacher opinion tends to drive decisions about how to configure educational groups in classrooms. As a result, queries about accountability and accuracy regarding student groupings remains robust (Glock, 2016). Despite the "detracking" efforts in the United States, tracking still widely exists in schools using new terms, and teachers still have preconceived notions about "ability level" and how to assess it. Looking forward, "problem-based learning and differentiated strategies in heterogeneously grouped classes may alleviate the issues surrounding ability grouping in the United States" (Worthy, 2010, p. 20).

Recently, data driven algorithms are in use to create data management systems with less bias when tracking students educationally (Klapproth, 2015). These current trends in assessment are helping to create a more equal and fair approach to organize students for learning. Moreover, differentiated instructional professional development and multiple intelligence theory is beginning to evolve and shape new curriculum (Gardner, 2011). Decisions about educational grouping affects all students in all schools, yet, beliefs about how people learn and how students should be organized continue to drive the debate. Polices about curriculum, whether local, state

or national level may support or hinder the use of homogenous or heterogeneous tracking as well as grouping methods within the classroom structure (Ansalone, 2010). Educational grouping research leads to new ideas and questions to fill in educational gaps and explore equity among groupings, how teachers view ability and data driven strategies and methods.

Science educational methods require teachers to use collaborative problem-based learning groups to promote curriculum that is aligned to NGSS curriculum. This curriculum fosters learning using inquiry and questioning as well as group collaboration among peers. Decisions about grouping students appropriately for problem-based learning activities may be essential for effective individualized learning (Gulpinar, Alkac, & Yegen, 2015). More research is needed to properly accommodate student learning needs most effectively in problem-based learning groups for science education.

CHAPTER THREE

METHODOLOGY

The main focus of this study was to examine and describe the perception of teachers regarding the role of educational student groupings on student learning of science concepts. This chapter describes the study's research methodology and includes discussions surrounding the following areas: setting in which the study took place, participants, data analysis and limitations to the study. Grouping students provides teachers different ways to individualize teaching and learning. This qualitative study addressed the general question of teachers' perception of the purpose groups serve during science instruction.

(a) What is the purpose of student grouping during science instruction?

(b) What groupings do teachers perceive as most effective for science instruction?

(c) How do teacher perspectives on NGSS science learning influence their grouping practices?

A better understanding of teacher perceptions about educational grouping effectiveness helps educators make informed decisions about student grouping methods. Conducting a qualitative study enabled me to document the experiences of middle school science teachers regarding educational grouping experiences, perceptions and opinions.

Educational grouping methods have existed in many different forms over the past century. However, recent changes in curriculum and shifts in educational standards have intensified the debate for many educational professionals. According to Vygotsky, learners can acquire knowledge more rapidly when working with others (Lippman, 2015). Similarly, Gardner (2011) finds that using multiple intelligences grouping arrangements based on learning style in conjunction with collaboration results in the most effective learning groups. "In any

instructional setting, the question of how classes or the students in class should be organized has consistently been debated" (Kim, 2012, p. 289). These theories, as well as NGSS mandates, were used as a foundation while seeking to understand the perception of teachers regarding educational groupings in the science middle school classroom.

Setting

A public middle school in the Northeastern United States is the site of this study. The site school is located a suburban town and houses approximately 900 students each school year. The site school consists of seventh and eighth grade classes, three administrators and roughly 100 teachers. Ten science teachers make up the staff of the science department in the middle school. The ten teachers instruct seventh and eighth grade, and teach general science. Each teacher has 75-100 students divided into four separate heterogeneously grouped classes and teaches both seventh and eighth grade curriculums.

The site study middle school was historically homogenously tracked by ability into four sections. Students were assessed in 6th grade based on state mastery test scores and data using marking period grades as well as teacher opinion. These scores and grades were used to place students in a track that reflected their achievement. This grouping method was practiced for over twenty five years. In 2010 school leaders converted to a heterogeneously grouped model that currently exists. Teachers are now responsible for four heterogeneously grouped cohorts, consisting of approximately 25 students each, with each class lasting 52 minutes. At this middle school, teachers are expected to teach with a variety of differentiated instructional methods, follow individual educational plan (IEP) regulations and adhere to curricular standards. I am among the science teachers employed at the middle school and have experienced the shift in

educational grouping over time. The study was conducted in the site study school and specifically focused on the science department.

Participants/Sample

The participants in this study were 10 middle school science teachers. Bloomberg et al. (2011) explain that this approach to selection of a research sample is purposeful. "The logic of purposeful sampling lies in selection information rich cases with the objective of yielding insight and understanding of the phenomenon under investigation" (Bloomberg & Volpe, 2012, p. 104). Creswell (2013) points out that it is essential that all participants have experienced the same phenomenon being studied. The participants of the study are all employed in the same school system and currently teach seventh or eighth grade science. Participants were recruited using a formal e-mail asking for participation and follow up took place in the form of a written note thanking the participant for their time. The science department was chosen based on its adoption of Next Generation Science Standards (NGSS) which promotes grouped learning as one element in the classroom to accomplish curricular alignment and goals. Each participant engaged in the research on their own time, answering interview questions provided by the researcher about grouping practices in their classrooms. I am familiar with the study site and share the same educational vocabulary as the participants.

Data

Data was collected in the form of individual interviews lasting approximately 30 minutes. The interview was one on one and recorded with an iPhone. Interviews were used to gain a firsthand account of teacher perception about educational groupings in their classrooms. In this study teachers were interviewed regarding their common experience using educational grouping methods in their heterogeneously grouped science classroom.

Interview questions were as follows:

1. Explain your overall experience grouping students in a science classroom during your teaching career.
2. How do you currently group students for learning and for what purposes?
3. What do you like/dislike about grouping students?
4. What are your opinions on the effectiveness of grouping?
5. What professional development have you sought or received on student groupings?
6. How has the adoption of the Next Generation Science standards influenced your instructional grouping practices?
7. How do school policies and structure influence the make-up of each of your classes?
8. How do you conduct formative and summative assessments? Do groupings play a role in how you assess?
9. How have curriculum materials and lab materials influenced the way in which you group students for instruction?
10. How do you incorporate problem-based learning into your classroom?
11. If you wanted to learn more about student grouping strategies how would you do that?
12. What is your most ideal student grouping for science education?

The data collection timeline was as follows:

- May, June 2017- Institutional Review Board proposal submission as well as the permission of the school cite
- July 2017- Interview question revision and finalization with input from advisors and cohort peer review.
- August 2017- Research proposal presentation

- September-November 2017 – Data collection- interview ten science teachers at the site middle school
- December 2017- Analyze data, begin to conclude findings.

Analysis

Creswell (2013) explains that analyzing qualitative data for themes will yield an explicit structure of the meaning of the lived experience. Interviews were transcribed by the researcher ensuring the complete interview is documented. Thematic analysis of the data was begun during the collection process as a way to organize content of the interviews, then data was reviewed and coded using the software Dedoose based on responses to questions asked during the interview.

Collected data was analyzed looking for thematic patterns. A coding system was used to ensure all statements were accounted for and are non-repetitive or overlapping. Meaningful units (codes) were grouped together based on the information gathered, and collected into themes, which was then used to describe grouping methods that were perceived to be frequent. When reviewing all of the data collected, the themes that focus on teacher perception and understanding of educational groupings were used as a guide to understand teacher beliefs about grouping students specifically during NGSS implementation. Findings, although obtained from a small sampling for this study, are able to be used to inform school systems in other United States geographical locations.

Participant Rights

Qualitative researchers need to remain attentive throughout the study and be aware of all human subjects' rights when conducting research. In this qualitative study, participation was voluntary, and the decision to participate had no impact on current or future relations with the site school or university because the identities of the participants are not reveled in the data

collection. Participants were allowed to skip or refuse to answer any question for any reason. Participants were free to withdraw from this research study at any time, for any reason. A copy of each participant's signed consent form will be retained for at least 3 years after the project is complete before it is destroyed. The consent forms and interview transcripts will be stored in a secure location, in a locked filing cabinet and password protected personal computer. In terms of risk, there was no foreseeable risk involved in participating in the study's interview process.

Potential Limitations

The information gathered through interviews will be helpful to teachers and administrators when assessing their options for using educational groupings in a classroom or professional development needed to further teacher education and awareness. Limitations include the small sample size of teachers interviewed as well as the limited location. As a colleague and participant of the school community, it was important to remain neutral, and recognize personal opinions and biases were present during data collection. All participants were made to feel comfortable in a semi-unstructured discussion during the interview process. In an effort to maintain objectivity and neutrality, validity checks were conducted throughout data collection. Information was restated and summarized in order to determine correctness. While these limitations were present, it may be assumed that findings were generalized and can be reflective of a larger population and perspective of middle school science teachers implementing NGSS standards and group assignments.

CHAPTER 4

RESULTS

The purpose of this study was to examine and describe the perception of teachers regarding the role of educational student groupings on student learning of science concepts. This study's findings may inform the educational community and guide future middle school science teachers in their decision-making about student groupings. This study was conducted in a middle school in the Northeastern United States and has an enrollment of approximately nine hundred students and has recently begun to adopt NGSS standards of practice. Participants in this study were all science teachers with experiences ranging from two years of teaching to twenty two years. All of the participants in this study have their master's degree in education and are currently teaching grades seventh and eighth.

Interviews were conducted with ten teachers who shared their experiences and perceptions about grouping students for science instruction over the course of their educational career. The overarching research question guiding the study was, *What are teachers' perceptions of the purpose of student grouping during science instruction?*

This study specifically addressed the following research questions:

(a) What is the purpose of student grouping during science instruction?

(b) What groupings do teachers perceive as most effective for science instruction?

(c) How do teacher perspectives on NGSS science learning influence their grouping practices?

This chapter will present, discuss and analyze data that was collected throughout the interview process. The interview questions were developed based on current literature and

science initiatives both locally and nationally. The semi-structured interviews were conducted from a sample of teachers with the following characteristics:

Participant Profile

Participant	Years of Middle School Experience	Courses Currently Taught
Participant 1	< 5	Physical Science
Participant 2	< 5	Life Science
Participant 3	6-14	Physical Science
Participant 4	15 +	Life science
Participant 5	15 +	Physical Science
Participant 6	6-14	Physical and Life Science
Participant 7	15+	Life Science
Participant 8	15+	Physical Science
Participant 9	15 +	Physical Science
Participant 10	6-14	Life Science

Ten interviews were conducted in total, each lasting approximately thirty minutes. The interviews were recorded on an iPhone and transcribed; transcriptions were presented to the participants to check for accuracy to validate the contents. A thematic analysis generated themes used by the researcher after transcripts were coded and reviewed.

Analysis Method

After completion of the interviews, raw data was retrieved from digital recordings. To preserve confidentiality, each participant was given a number within the transcribed data. Coding was used to describe, classify and interpret data. According to Creswell (2013), "the process of

coding involves aggregating the text or visual data into small categories of information" (p. 184). Three rounds of thematic analysis were used as a comparative method to create categories and identify themes. In the first round of coding the interviews were uploaded to a data management software called Dedoose. Using this software, each set of interview question responses was coded with an open coding system that highlighted important concepts and singled out certain meaningful quotations and phrases specifically related to the research questions. Dedoose created a clear and direct way to analyze data and compile results accurately. Thirteen codes were identified and a highlighting color coded system was used to visually represent data. The thirteen codes included but were not limited to: teacher frustration, random grouping, funding, special education, effective grouping practices, NGSS grouping practices cooperative learning and behavioral concerns. During the second round of coding each interview was thoroughly checked for commonalities and the initial content was condensed. In the final stages of coding, commonalities were analyzed and different codes were combined to allow four strong themes to emerge from the data.

Presentation of Results

The results of this study are represented by themes. Reviewing the transcripts created a clear view of the commonalities each of the ten interviews shared. After coding the interviews, categories emerged resulting from teacher experience and perspectives. Many of the responses were similar, creating a clear indication of parallel data throughout the study. Major themes identified in this study are presented in the chart below:

Final Major Themes	Round 2 (refined) Categories	Round 1 (initial) Categories
Theme one	Learning styles Grouping methods	Cooperative Learning Mixed ability grouping

Cooperative groups support student learning	Individual Student Assessment	Effective grouping Random grouping
Theme two Staffing support is needed for teachers to focus on grouping approaches	Limited special education support	Behavioral concerns Ability grouping True heterogeneous
Theme three Mandates influence teacher ability on grouping	State, Local, Federal Mandates	Support (Special Ed) Funding Frustration
Theme four Professional development and NGSS training	NGSS practices	NGSS grouping practices Professional development

The four themes used were: cooperative grouping, limited support, mandates and professional development. They are presented in the next section with excerpts from each participant.

Theme one:

Cooperative groups support student learning

Theme one emerged throughout each interview as teachers referred to their grouping as 'cooperative grouping'. As indicated by five of the ten participants interviewed, a school-wide push for differentiation occurred at the research site nine years ago. As a result of that initiative, students were organized into heterogeneous grouping and teachers were required to use grouping

methods as a form of differentiation in their classroom. Participant 4 explained the change from teaching homogenously to heterogeneously.

> When I first started teaching my classes were grouped homogenously, I had two groups of my higher students called 1A and 1B and then I had an average group 2B with some behavior problems and a collaborative class 2A with special education students and a lot of support. They were grouped for me by effort and behavior. Now I teach students that are mixed abilities (heterogeneously) they are random. There are top kids with low kids and some with high ability (Participant 4).

The change of grouping arrangement in the school fueled teachers' beliefs and they developed strong opinions about educational grouping. Some teachers indicated that, while there might be benefits, they did not feel time was dedicated to prepare for instruction required for heterogeneous grouping.

> While there are certainly some benefits of heterogeneous grouping, I think of it as a way to minimize the amount of staff you have in a building, it put a tremendous amount of additional work on the teacher for planning. If given that time it could be effective but in most cases it is switched from homogenous grouping to heterogeneous grouping and the potential benefits aren't realized because of a lack of time to effectively prepare for those courses (Participant 5).

The participants felt that students learned best in a cooperative environment, usually paired with a peer of equal or different ability. All of the participants interviewed have taught in classrooms that were heterogeneously and homogenously grouped. All ten participants agreed that they include cooperative grouping into their classroom in some way. Participant 3 said,

> I like it when I can have students cooperatively learn, I think it's really important for science. I really like to have a group with most of my lower students together (with support of a collaborative teacher or paraprofessional) and most of my higher students together so I can really challenge them especially with current topics.

Cooperative learning is clearly embedded in the classrooms of the participants because, in their opinions, it is the most effective way to learn. Benefits of cooperative learning in science were indicated in some way by all participants. Cooperative learning fosters an environment where the students help each other which frees the teacher to focus on students they feel need more attention. This was indicated by Participant 1 who stated "I like that the kids are able to work with each other and not rely on me- I like that they can problem solve together and I am the last resort when trying to figure out an answer. This way I can focus on my special education population." Each participant openly shared their experiences and perspectives on grouping students.

They all indicated that, in their classroom instruction they use grouping as way to maximize activity time, support staff and material resources. Participant 5 shared insight into the challenges teachers face when attempting to group students effectively for instruction, stating,

> Grouping students is a challenge, finding the right combination of students to work effectively in a group to avoid the one leader that does all the work and the students that tend to just go along with the group. Finding that dynamic before you place your students in a group is key and that's a hard thing because there are all different ways, from giving them surveys on their multiple intelligences to finding out how they work. (Participant 5)

Participants explained how they individually assess students in a cooperative group setting for both participation and learning. Teachers voiced concerns on how learning was assessed fairly when grouping students together in the classroom. Most participants expressed concerns in reference to uneven workload.

> As long as all the students are participating I don't have a problem with them working in a group and me assessing them, sometimes the lower students cannot do the work alone, which is why grouping is effective, however, I need to make sure that they are not just sitting there and letting the higher level students do it. (Participant 3)

Another participant addressed the challenge of task completion in heterogeneous groups by stating the following:

> Depending on what we are doing I try to have a group grade or a group portion of it so that even the lower kids can achieve to a certain degree. Even if they don't do well on an independent part they can still do well on the group part. You always have to make sure that all the students are doing work and it's not just one high kid doing all the work the whole time. (Participant 6)

Participants indicated a need for professional development to develop strategies for assessing students in a collaborative setting.

"I don't think I have ever actually done any assessments within a group setting- so much as I assess individually after the group project is done, I do think it is a really good idea and I would like to be able to do this. I just don't know how I could go about doing it." (Participant 1) Another participant had a similar opinion about the challenges of assessing students within the group setting. "Grading in groups is difficult because one or two students do all the work while

other students do nothing. I have talked to other teachers about strategies to the problem I am torn on these strategies as well." (Participant 2)

Overall, participants indicated that, in their classrooms, they use grouping on a day to day basis. In all ten interviews the major grouping methods discussed were homogeneous and heterogeneous grouping. Cooperative grouping was considered to be among the best ways in school for students to experience relevant learning over time and engage with their peers in real-world experiences. "If you look at the real world, very rarely does someone work all by themselves beyond the scope of their career" (Participant 9). Students are able to create a "platform to exchange ideas" (Participant 8) through grouping methods that use cooperative learning.

Theme two:

Staffing support is needed for teachers to focus on grouping approaches

Theme two emerged as a major theme encompassing special education, student behavioral concerns and the frustration teachers feel about classroom management. Throughout the interviews participants identified significant differences between each of their heterogeneous classes. Participant 1 explained that "Grouping is most effective when there is support in the classroom environment and students are able to cooperatively learn together while also being supported by teachers". Interviewees expressed concerns about grouping ineffectively due to lack of instructional support personnel in the classroom. Teachers indicated that 'lack of support' meant lack of a Special Education teacher, lack of paraprofessionals for Special Education and behavioral concerns within the classroom. Participant 3 was the most boisterous about this particular topic stating, "The staffing support makes a difference! I essentially have homogenous grouping and it works really really well. I feel effective in each class. I also have a

tutor in my class to help with special education students and I have a collaborative special education teacher." Seven of ten participants expressed concern where their classroom could be better grouped with more support from a special education teacher or paraprofessional in the classroom. "I need a Special Ed teacher or paraprofessional to make real heterogeneous grouping most effective" (Participant 7).

Many participants explained that because of the lack of Special Education teachers, their classes were not truly heterogeneously grouped. Participant 5 best described the class make up as follows:

> We have on paper 'heterogeneous grouping' and the grouping within the school is structured so that the students are randomly selected to be within teams and therefore heterogeneously grouped. There are caveats within that thought. For instance, if they have an IEP and require Special Ed services there are a limited number of teams that provide these services; so those students go there. If they have academic needs (for example, some algebra versus pre-algebra), those students are placed in those teams. And once you get through all of those you have students that are limited if they are in band or a language. Then out of that small percentage you can honestly heterogeneously group the students, but those teams that provide Special Ed services because of the high numbers have a very high percentage of Special Ed students.

Participant 2 also expressed logistical concerns regarding the heterogeneous make-up of the students in each classroom. "While I understand there is a limited schedule and a limited number of staff that can service these students, it really weights the classes down and while they say it is a heterogeneous grouping our classes can be heavily weighted in a group."

Behavioral concerns that influence the grouping of students was also discussed by participants. Behavioral concerns arise because of the lack of support in the classroom to accommodate all students and their individualized needs throughout learning. Often students will become frustrated or bored and act out due to inadequate support in the classroom. As a result, teachers were hesitant to group students together for assessment because of the behavior exhibited during group work. Participant 1 presented this perspective, "I think sometimes it's tough when you have kids that don't want to work with other kids or you have kids that are so close to each other that they mostly just want to goof off in the groups." Participant 2 expressed frustration about student behavior in groups, indicating that "grading in groups is difficult because one or two students do all the work while other students do nothing."

Staffing support within the classroom was indicated as a concern based on instructional behavioral problems created because of the change to heterogeneously grouped classes in 2009. All participants agreed that they lacked support in their classrooms and as a result, were not able to group students as effectively as they wanted. Participant 8 was very emotional stating that "I see the difference grouping makes for special education students," referencing that support is needed for the students to be integrated into the classroom and small grouped effectively with regular education students. As a result of lack of staffing support in the classroom, it is evident that teachers were frustrated and feeling that this particular subject was often discussed without any changes in classroom make up, forcing grouping methods to be less effective as compared to a classroom with ideal special education support.

Theme 3:

Mandates influence teacher ability on grouping

The third theme to emerge was closely related to the lack of support given to teachers in the classroom. Teachers indicated that state and federal mandates have hindered their ability to adequately group students for science instruction. Lack of funding was the most common reason why teachers interviewed were not able to group students in their classroom for what they perceived to be the best instructional groups. "I mean, if there are not enough materials there is only so much you can do in groups" (Participant 2). Participants explained how it is hard to complete a lab activity in their class due to the lack of funding. "Sometimes it's just necessary to do a whole group activity or demonstration for time and cost purposes" (Participant 4).

Necessary whole group activity hinders individual group assessment and engagement in classrooms. Teachers described how they use their own money so that they can successfully group students for instruction. "Depending on what I have available is what we are able to do as a group. I buy most of my own materials for different labs so I can group students together in small groups rather than using materials to just demonstrate as a whole group" (Participant 1).

There are many reasons why school districts limit funding, however participants expressed clear concern about lack of funding hindering the educational success of all students. Teachers articulated concern for their students' lack of access to materials and explained how they spend their own money to complete fun and engaging grouped lessons to meet curricular objectives. Participant 5 expressed frustration in responding to mandated curricular objectives that are not allotted funding. They are therefore unable to successfully reach these goals. "I ask students to sometimes bring in materials if they can and they sometimes do, but I spend a lot of

my own money as a lot of teachers do that are required to complete the curricular objectives" (Participant 5).

After hearing of these frustrations during the first interview the researcher asked a follow up question. The question was "If there were no mandated restraints what would be your ideal grouping situation?" Teachers expressed a need for materials and support but also indicated a desire to teach truly heterogeneously. "I would have a lot of support with special education and have true heterogeneously grouped classes" (Participant 10).

Educational grouping strategies and methods cannot be integrated into the classroom when mandated decisions limit teachers' ability to enact those approaches. The quality of education students are provided is influenced by lack of structural and personnel support. Lack of funding, instructional support and class structure are all factors that cannot be controlled by the individual classroom teacher. Rather, it is administrators who determine class make up and state and local government that determines funding. As the participants indicated, these classroom dynamics contribute to effective or ineffective student groupings.

Theme 4:

Professional development and NGSS training

The last theme to emerge from the data concerned professional development that has been offered to the teachers as well as NGSS training. All ten teachers that were interviewed said that they have not received training specifically geared towards educational grouping. Indeed, most teachers interviewed were extremely short in their response when asked "What professional development have you sought or received about educational grouping?"

> "I don't think I've ever had any professional development on student grouping. So, to my knowledge none" (Participant 1).

"None to the best of my knowledge" (Participant 7).

"I cannot think of any off hand" (Participant 4).

"I can't say I have received any specific professional development on grouping, however it has been included in professional developments addressing Next Generation Science Standards" (Participant 2).

Participant 5 went into more detail then the other interviewees by explaining,

> Little and early on when our school went from homogenous to heterogeneous grouping they cited a lot of research from schools that had effective heterogeneous grouping and many of the schools were charter schools or magnet schools or smaller schools with small class size and in some cases more than one instructor per class. Not in all cases, but they certainly had small class sizes. So I actually have never had any actual effective professional development about grouping. There is an assumption and an expectation as far as what should be done in a heterogeneously grouped classroom, and as a result, I should have received training to meet those expectations. (Participant 5)

Professional development is a tool to educate teachers on current effective classroom instructional strategies. A new initiative in all science classrooms are National Science standards. NGSS grouping will effect each science classroom in the United States. Teachers reported that consulting their peers or browsing the internet was the most common source of educating themselves in reference to learning about effective educational groupings or any new instructional strategies they would like to implement in their classroom. Participants also explained training for NGSS citing that they have little or no training. "I have not yet received any training on the science standards. I was scheduled and it was cancelled. I think some people have received the training but as of now, it hasn't changed my class at all" (Participant 4). It is

important to note that the school system leaders have made an attempt to offer professional development opportunities in the district; however, it was not mandatory to attend.

Next Generation Science Standards (NGSS) explicitly mandate the use of groups for discussing scientific principles. "NGSS practices require more intensive student discussion that are essential to the framework, practices such as developing and using models, constructing explanations, and engaging in argument from evidence" (Penuel et al., 2015, p. 45). Participants found that collaboration in the classroom is encouraged when students are engaged in active learning. Students can be grouped any way the teacher deems necessary for the learning activity. Participants shared similar responses when discussing how NGSS has affected their classrooms stating that "It hasn't really effected how I teach because I would teach the same way" (Participant 10). They agreed that their instruction before NGSS was adopted was already highly collaborative and grounded in inquiry based practices.

NGSS mandates and highly rigorous lessons will eventually create pressure for each science classroom to teach collaborative project-based lessons that promote educational grouping. As of right now, NGSS mandates and teaching strategies are still new in school systems. Science teachers will ultimately need to embrace educational grouping that promotes a cooperative learning environment during science learning within their classrooms.

Summary

The purpose of this study was to examine and describe the perception of teachers regarding the role of educational student groupings on student learning of science concepts. Through the interviews of ten middle school teachers, a clear picture of their perceptions and experiences was drawn. Four themes were generated from the interview transcripts.

Theme one focused on cooperative grouping. Participants indicated that they use cooperative grouping in their classes currently and perceive these groups as effective ways to learn science curriculum. However, teacher interviews did not distinguish between type of cooperative groupings or assign a grouping strategy. Teachers explained that sometimes they use cooperative groupings in an attempt to maximize supplies needed for innovative science activities. Teachers also expressed the need for individual assessment in a group setting to create accountability for all students working in a cooperative group.

Theme two focused on classroom personnel support. Interviews revealed that teachers feel the lack of personnel support in their science class hinders grouping approaches. Participants also indicated that because of the lack of personal support cooperative grouping is useful to engage all students while working one on one with students in need of extra help or extension. Classroom support refers to special education teachers, and paraprofessional staff integrated in a collaborative teaching environment. Participants described the need for support to address student behavioral concerns when classroom learning is disrupted.

Theme three focused on federal, state and local mandates. Lack of funding, instructional support and class structure are all factors that cannot be controlled by the individual classroom teacher. Participants indicated these factors contribute to a lack of appropriate educational grouping and time to use strategies to group students for multiple learning purposes. Interviews explained that the make-up of each class structure also contributes to educational grouping hindrances.

Theme four focused on teacher professional development and training. Participants expressed the need for professional development focused on educational grouping strategies. The internet was specified to be the most influential place for information regarding educational

grouping strategies, as well as peer to peer guidance. Participants were in agreement that more training is needed to gain information and understanding of NGSS as it is a new initiative.

Results demonstrate that teachers believe that middle school educational grouping is most effective when students are grouped cooperatively for student learning. For students to effectively work in cooperative groups teachers indicated that methods used include grouping randomly, mixed ability, by reading level, or multiple intelligences. Support, however, is needed within the classroom setting for grouping methods to be in place accurately. Behavioral concerns were noted to be controlled with more support given to classroom teachers, directly resulting in effective collaborative grouping measures. The study found that hindrances from federal, state and local mandates make grouping within the classroom limited and frustrating for teachers due to lack of funds and true heterogeneously scheduled classes. Results also indicated that teachers did not perceive their classrooms being effected by NGSS groupings. More importantly, teachers looked to peers for guidance about grouping methods as a direct result of professional development received focused on student grouping strategies.

This study was designed to more fully understand the perspectives of teachers regarding the role of educational student groupings on student learning of science concepts. The lessons learned here and the common perspectives gathered can help to guide teachers at the site studied and other science teachers to more effectively group students for learning based on teacher perception and experience.

CHAPTER 5

CONCLUSION

This study examined teachers' perceptions of student grouping and learning in a science classroom. The purpose of this qualitative, phenomenological study is to examine and describe the perceptions of teachers regarding the role of educational student groupings on learning science concepts. The review of the literature identified studies about the purposes for grouping, the role of assessment, teacher reform and decisions as well as teacher stressors. The studies also supported many different grouping methods among teachers. Next Generation Science Standards (NGSS) have begun to push teachers to create an environment that supports student-centered learning and employs instructional methods that encourage grouping students together for science learning. Teachers are being required to use strategies that promote student collaboration and groupings for everyday science instruction. In turn, teachers must re-create their own idea of science education and step away from a lecture-based approach. Teachers will be challenged to make instructional based decisions using their prior experiences and new NGSS training. These unique perspectives may be different for each individual due to teacher recognition of the benefits and true understanding of NGSS curricular alignment. They must embrace a constructivist approach and implement hands-on student centered activities to engage students in learning new science concepts.

In order to determine teacher perspectives, ten individual interviews were conducted to gather data document perspectives and beliefs about classroom grouping methods from science teachers. The research was framed using Vygotsky's theory of the zone of proximal development and Gardner's theory of multiple intelligences. These theories inform the rationale for why constructivist approaches are supportive of science learning.

Specific interview questions were designed to gather teachers' perspectives on grouping students for science instruction and gain insight on how grouping practices that have been used as well as the ways teachers learned grouping methods. The data collected was thematically analyzed, coded and themes were identified. An analysis yielded information that was similar in nature across all interviews. The four themes generated were:

1. Cooperative Groups support student learning
2. Staffing support is needed for teachers to focus on grouping approaches
3. Mandates influence teacher ability on grouping
4. Professional development and NGSS training

Teachers perceived groups as a way to maximize class time and utilize groups to strategically enhance learning. Grouping methods were not consistent, however due to teachers' beliefs about grouping and a perceived lack of common professional development received by the science teachers. Creating different levels of comfort and knowledge surrounding grouping methods effective for differentiated practices. Overall, the data analyzed painted a picture of how teachers perceive the use of grouping methods for science instruction.

Interpretation of findings

An overarching question guided the research approach and the data collected in this study. Interviews provided data that answered the questions being investigated. The interpretation of findings are presented and linked to the overarching research question, which was, *What are teachers' perceptions of the purpose groups serve during science instruction?* Three individual research questions supported exploration of the more general question. This study specifically addressed the following research questions:

(a) What is the purpose of student grouping during science instruction?

(b) What groupings do teachers perceive as most effective for science instruction?

(c) How do teacher perspectives on NGSS science learning influence their grouping practices?

Findings from the data are reviewed within the three research questions below.

Research Question One: What is the purpose of student grouping during science instruction?

Results show that teachers view the purpose of grouping as a way to structure students in to groups for cooperative learning and maximize class resources. Science classroom resources can be costly and a lack of funding has limited classroom resources. Lack of resources influence teachers' use collaborative groups to consolidate resources needed for science activities. Results also indicated that grouping methods helped to teachers pace curriculum and teach standards in a timely manner by utilizing classroom support staff to accommodate special education services or one on one time for students requiring individualized assistance. Participants report grouping methods as a form of classroom management to keep all students on task and working together towards a common science goal. Data showed that participants felt as if the efficacy in planning learning groups was limited by federal, state and local mandates required by the school district. These mandates included funding, larger class sizes as well as behavioral concerns and lack of support for students with special education needs.

As mentioned before, challenges in implementing curriculum to create 21st century skills require teachers to respond to pressures to reform their way of instructional methods (Aslan, 2015). A process such as effectively grouping students can be a puzzling new venture as a response to innovative curriculum or science standards. Literature reviewed above indicates some teachers find it hard to create an identity for themselves because of outside opinions and

beliefs about education (Bower & Parsons, 2016; Park, 2017). This research fully supports other findings that indicate that teachers feel as if they are limited by federal, state and local mandates reforming how they must teach. Additional stressors include a lack of resources, lack of special education student support and large class size. These factors affect teachers' decisions about when and how to group students for science learning.

Implications

The findings in this study will be useful to the educational community on a local level and are most beneficial to the district's science department. The findings in this study support similar teacher perspectives about educational groupings in the science classroom. Some teachers viewed student groupings as a classroom management technique. Some teachers felt that groupings decisions were a response to inclusion policies in special education. When analyzing data from ten teacher interviews, it was clear that different ratios of student groupings could be present in each team. Teachers recognized the need for more special education support in the classroom.

Research Question Two: What groupings do teachers perceive as most effective for science instruction?

Findings indicate that cooperative learning is perceived by teachers to be the best method through which students learn in a science classroom. Data revealed that teachers group students so that cooperative learning can take place. Participants believe that cooperative learning maximizes activity time, classroom support and resources for science curriculum. Students are able to learn through peer interaction and problem solve together creating real life scenarios that foster 21st century skills needed in the workplace. Students are able to maximize cooperative learning in an environment where teachers are free to work with students who need

individualized attention. Additionally, the data shows that teachers have not been provided adequate professional development regarding multiple grouping methods that utilize cooperative learning as indicated in the literature. Rather, teachers indicated that they sought their own information about grouping inquiring from peers, books or internet resources.

Research has shown that cooperative learning promotes interaction and communication among group members and enhances engagement in the learning process (Jurkowski & Hanze, 2015). Teaching and learning was perceived to be most effective when cooperatively learning groups were implemented. Literature supports these findings and links the ideas and thought to data collected during interviews.

Implications

It is evident that teachers view educational groupings as a form of classroom management, as well as a method used to enhance the educational rigor in the classroom. Cooperative grouping was the most common form of grouping used in the science classroom indicated by interviews. Teachers see this form of grouping as a way to utilize resources and free themselves to teach in smaller groups or with specific individuals as other students work cooperatively to learn. However, most participants were unclear how grouping methods could be used to enhance science teaching and learning beyond cooperative learning.

Research Question Three: How do teacher perspectives on NGSS science learning influence their grouping practices?

The data clearly shows teachers were actively using cooperative grouping in their classrooms before a mandated NGSS grouping practice was initiated. The school district has adopted the NGSS standards and is working towards full implementation in the classroom, however, data shows that at this time, classroom grouping has not been affected. Teachers

perceive the NGSS standards as a different style of teaching, yet grouping students has not changed for them when working towards science classroom goals and objectives. Teachers are now more aware of NGSS groupings and have found the integration of new "talk moves" to be a smooth process. Data also indicated that teachers still needed to be trained regarding NGSS talk moves mandates and regulations as most of their knowledge was gained from limited professional development and internet resources.

"Rapid changes within society demand changes in education. To meet such changes, education can be expected to undergo reform and accordingly, new curricula need to be developed" (Valdmann, Holbrook, & Rannikmae, 2017, p. 576). Teachers will be mindful of the changes that need to occur in their classroom. With proper preparation, adoption of NGSS standards will be a seamless transition. Stakeholders will need to work together and support science classroom teachers by sharing ideas, grouping strategies and classroom management techniques while moving forward with new curricular alignment.

Implications

Findings from this study indicate that science teachers realize they are grouping students for science learning with limited professional development offered to help answer questions or offer supportive grouping strategies related to NGSS standards and talk moves. Additionally, administrators may become aware of the significance grouping plays in the science classroom as NGSS standards becomes more prominent in daily curricular objectives. Administrative professional perspectives may be similar regarding student groupings, and they too may need to gain more knowledge through professional development for evaluation purposes. Making the study site district leaders aware of needed professional development may create a spiral effect throughout the neighboring districts and open up communication about NGSS grouping methods

on a state and national level. Using this data to inform district leaders of needed professional development will be useful to science teachers and students, and change how science is taught in middle school classrooms. Teacher perception that NGSS is simply cooperative learning gives a false sense of academic rigor. Rather, teachers must be made aware of constructivist approaches to instruction and use NGSS initiatives to guide productive NGSS science teaching and learning.

Overall, this study found that teachers group students with a purpose to collectively learn in a collaborative environment. They also use grouping as a way to maximize their time and resources. Grouping was found to be most efficient when students were working together cooperatively as engaged participants, free from behavioral distractions and supported with special education staff when needed. NGSS influenced classroom instruction by aligning curricular standards and introducing a high level of inquiry, collaboration and 21st century skills. These findings support the need for educational grouping professional development for seventh and eighth grade science teachers to strengthen their understanding and practice within the classroom as NGSS standards become mainstreamed and prevalent as the district aligns science curriculum K-12. A deeper understanding of how NGSS standards integrate with cooperative grouping and talk moves can help district leaders support teachers to elevate academic rigor in science.

Analysis of Findings

The data collected indicates that teachers perceive cooperative learning as a way to enhance curricular goals and objectives for students. “Vygotsky’s theory of the zone of proximal development says that learners can acquire knowledge more rapidly when working with others more expert in a given task” (Lippman, 2015). Vygotsky’s theory is helpful when examining the perspectives that teachers have about student groupings. Teachers agree that grouping students

for learning is needed; however, the data shows that teachers do not always consciously group students purposefully, rather random grouping may be used more often in the classroom. Teachers also indicated that grouping was based on behavioral concerns or student choice. In both circumstances students were able to cooperatively work with students they felt they communicated with best.

Howard Gardner's Multiple Intelligences Theory has been an effective way for teachers to understand that all students learn differently. Personalized learning for each student can be possible when teachers purposefully group for understanding and focus on individual strengths for learning. Understanding both Vygotsky's and Gardner's theories is critical to the effectiveness of student groupings in the classroom. Teachers must be mindful of how and why they group students for learning. Interview data indicated teachers spend time thinking about activities that engage students to work together using multiple forms of learning despite the lack of resources they have for science instruction and the little professional development they have received.

Limitations and Discrepancies

The data gathered in this study are limited to one middle school in a New England public school district and focused only on seventh- and eighth-grade learning. In addition, a majority of the teachers interviewed have limited experiences at any other school district. This is a limitation because the perspective of the teachers reflect knowledge of only one district's approach to science learning. It is also important to note that the researcher is a peer teacher and the potential for bias was well recognized while interviewing.

It is clearly evident that answers were consistent across all interviews and grade levels. Teachers indicated that they all use cooperative learning groups, however, data interpretations

were not clear if the teachers had the knowledge to why grouping for different types of students would be successful/unsuccessful. Teachers knew "common grouping lingo" such as *cooperative* and *heterogeneous,* but it was unclear if the teachers understood the theory behind educational grouping methods. Confusion regarding grouping methods reflects teachers' feeling a need for professional development to educate themselves to improve their practice. Teachers consistently answered that they did not have any formal professional development regarding grouping methods.

Consistent responses strengthen the interpretations of the findings despite the potential limitations that the study conveyed. Several categories and four refined themes emerged from the collected interview data. In the event that the interviews were inconsistent it may have been necessary to interview a larger sampling to gain more consistent data. Clear themes developed by means of the data collected from the ten teachers interviewed.

Transformative Learning and Leading

Understanding teacher perspectives about educational groupings gives positional leaders an insight into the way classrooms are structured for learning. Teacher opinion can drastically change the classroom goal, atmosphere and collective learning environment. Effective teaching employs a transformative learning approach where teacher and student work collaboratively to achieve a learning goal. Transformative leaders must recognize that changing the mindset of a teacher by educating them about grouping strategies can strengthen the learning environment and effectively change approaches to science instruction. A school curriculum that is geared towards NGSS standards and 21st century learning strategies for the workplace will include attention to grouping strategies. Classroom vison and teacher perspective encompasses all stakeholders and effects the lives of students and their communities.

Transformative leadership is a style of leadership where the leader works to motivate followers to change using a collective mindset, shared vision and committed group members. Working together as a team, the leader and group members effectively change an organization by allowing a more smoothly functioning operation. Transformative leaders use goal oriented strategies to learn in a collaborative environment with collective thoughts and shared experiences.

Findings Related to Literature

This study has its grounding in topics which were developed and linked to previous literature. The findings in this study align with literature cited. Multiple forms of educational grouping methods were discussed throughout the interviews. Participants in this study support the work of Gardner (2011) and McFarlane (2011) recognizing that differentiated instructional methods as well as purposes of collaborative work is essential to enacting ability grouping and reform. Cooperative learning as discussed by Jurkowski & Hanze (2015) was referenced by participants as their perceived most effective form of educational grouping.

Additionally the literature outlines various types of grouping methods. Mixed ability grouping was most commonly discussed by participants. Research by Lotan (2009), Boaler (2006) and Rowcliffe (2006) support mixed ability grouping in the classroom as a method that is most effective coupled with the use of cooperative learning strategies. Literature in support of detracking (Klapproth, 2015; Karlson, 2015; Cate, Schwerdt, & Glock, 2016) encompassed the thoughts and perceptions of the teachers in the research site school district.

Other literature documents the importance of 21st century learning and implementing NGSS standards. Research cited by Larson & Miller (2012) as well as Cate, Schwerdt, & Glock, (2016) call for a need to expand NGSS knowledge and understanding to implement standards in

the best way possible for students. This recommendation includes professional development and effective use of student groupings to enchase collaboration and learning across the science curricular standards. Stressors such as workload, lack of personnel support and lack of resources were indicated in the data. Research addressing teacher stressors was supported by evidence from literature by Albu (2012), Richards (2012) and Jennings (2017).

Recommendation for Action

This study aimed to understand and document teacher perceptions about how they group their students for educational purposes. Teachers benefit from the data gathered because the findings can inform decisions made at the department and school-wide level. Student grouping professional development has not been prioritized at the middle school level, and as a result the purpose for grouping is not well understood by teachers. Once a purpose for student groups in science classes is established, different strategies for grouping with intention can be implemented. Curricular objectives are put in place by external mandates, and, as a result, teachers perceive themselves as reacting to those mandates, perhaps without necessary resources. A lack of special education support in the science classroom is evident from the findings along with resources needed for effectively grouping students for learning.

Professional development is recommended to increase teacher awareness and knowledge about the purpose of grouping students for NGSS science learning and also as a way to encourage productive “student talk” . An open line of communication about federal, state and local mandates and their influence on curriculum is needed. There is a potential for the study’s findings to impact each classroom as professional development is implemented and teachers begin to use strategies gained in their everyday collaborative NGSS lessons. Transforming the teacher perspective about grouping and demonstrating the purposes of student grouping in the

classroom will help teachers to effectively group students for science learning and productive talk in every NGSS lesson. Recommendations for this district include offering professional development centered on student groupings and providing special education support to teachers as they begin to implement rigorous science curriculum, productive talk and NGSS across the district K-12.

Benefits to Stakeholders

The findings suggest there is a need to create a change within the district and perhaps locally, state-wide and nationally. It was noted that teacher perceptions show that science learning is most effective when students were collaboratively grouped with purpose. Students benefit from educational grouping by simultaneously gaining skills needed in the workplace and cooperatively learning together as a team. Teachers, students and administrators gain insight by studying the perspectives of all stakeholders in regards to student grouping and learning. A shift in science education can occur through the use of professional development informing teachers on useful ways to teach with a student centered approach. The future of development of a productive workforce relies primarily on collaboration between diverse members of the community. Cooperative learning and 21st century skills can help to prepare all students to be productive members of society. Grouping students effectively for learning can help to create skills needed in future years.

How the Results Might be Disseminated

The results of this study will be shared with all ten teachers that participated in the interviews, the science curriculum team, middle school leadership team, and the middle school administrators. To assist in the future planning regarding professional development the results will be shared with the Director of Curriculum and Instruction as well as the Assistant

Superintendent and Superintendent. Furthermore, the Board of Education and union representatives should be aware of the study's findings will be used to garner board approval regarding new initiatives, instructional coaching positions or professional development budgeting appropriation.

Recommendations for Further Study

This study shows consistent data regarding how science grouping is perceived, used and understood by teachers on a middle school level. With the newly initiated NGSS standards being implemented in grades K-12 district-wide it would be important to gather the same set of data concerning science groupings across all grades. Understanding the perception of teachers K-12 will give the district a wider lens when deciding what science professional development is needed concerning student groups. It would be interesting and valuable to see if the concerns and understandings of the middle school teachers in the district aligned with the elementary and high school science teachers. Aligning science teacher perspectives and ideas may help to cohesively bond all stakeholders together and allow them to work towards a district goal in terms of educational groupings and NGSS alignment. Student perception of NGSS through their own voice would be a valuable tool to understand how NGSS productive talk and collaborative grouping supports science teaching and learning. Understanding student and teacher perspectives about NGSS curricular objectives would further rigorous science curriculum as both teachers and students make meaning of NGSS while drawing on their existing perceptions and practices.

Findings suggest that teachers would benefit from coherence across science classrooms. Due to my close observation of the site school I would propose hiring science a district science coach to unite teaching strategies, promote productive student talk and align all K-12 classrooms

with NGSS standards. Coaches play diverse roles in supporting teachers and instructional practices. A science coach could work to close the science informational practice gap between recommended NGSS instructional practices and current practice across classrooms and schools within the district. Expanding the study statewide and nationally as NGSS standards begin to be adopted across the United States may have powerful effects on teaching and learning in all science classrooms. Effective student groupings based on theory-based purposes will also provide opportunities for students to learn 21st century collaborative grouping skills before they enter the workplace.

Conclusion

Educational grouping practices are essential to an effective science learning environment using NGSS standards. Teachers have complex jobs that require them to work under a large amount of stress as well as the carry the responsibility of providing excellent instruction in a system where resources may not be readily available. On site, teachers use grouping strategies as a form of classroom management as well as an enhancement to classroom cooperative learning.

Data reveled that teachers felt too overwhelmed with common, workplace stressors to fully engage with ideas about how thoughtful grouping can affect the learning environment in a science classroom. Lack of special education support in the classroom and limited professional development has created a middle school staff that understands grouping as a convenience as well as an educational teaching strategy. Teachers believe that cooperative learning is the best way to teach in their classroom. With that said, it is common for educational grouping strategies to be used without a specific purpose. Data supports findings that this staff that is in need of extra support within the science classroom as well as professional development to support

effective grouping strategies and gain a deeper understanding of NGSS practices such as productive talk in collaborative groups. Organizationally, school districts benefit when all students are actively engaged in the learning process and can achieve a level of success while changing themselves appropriately. Recommendations for further studies in the area of teacher support, stressors, student voice and teaching techniques is recommended.

Reflection

My expectations as the researcher were not supported by my findings. It was my assumption that teachers perceived NGSS as a change within their classrooms. However, quite the contrary, teachers perceived NGSS standards as new standards replacing old standards where teaching students is the only change. It is true that NGSS standards require inquiry and a full student- centered approach, nonetheless, it is evident that the lack of understanding is a direct correlation to the lack of professional development within this school site. As a result it has created confusion in regards to NGSS student productive talk needed to create a successful collaborative NGSS learning environment. Many teachers are unaware of their lack of knowledge regarding purposes for educational grouping in the 21st century. Science teachers need to prepare students for productive group talk and teach skills for scientific data analysis rather than inform students solely about science facts. NGSS will reform classrooms as the emphasis on concepts will shift to scientific analysis strategies while conducting rigorous curricular standards.

As the school district in which the research site is located moves forward, there are implications for the role of NGSS. This study's findings will provide a sound rationale for reform. Recommendations for school leaders include reviewing the existing literature on educational groupings, attending to and addressing teacher's feelings, perceptions and needs,

outlining next steps for improvement of science education, and providing science instructional coaching support.

REFERENCES

Abu El-Has, T. R., & Rubin, B. L. (2009). Realizing the equity; minded aspirations of detracking and inclusion: Toward a capacity-oriented framework for teacher education. *Curriculum Inquiry*, *39*(3), 435-463. http://dx.doi.org/10.1111/j.1467-873X.2009.00451.x

Albu, G. (2012, July 1). The teacher's worries and concerns. *Journal of Educational Sciences and Psychology*, *2*(1) 57-65. Retrieved from http://web.a.ebscohost.com

Ansalone, G. (2010). Tracking: Educational differentiation of defective strategy. *Educational Research Quarterly*, *34*(2), 3-17. Retrieved from http://erquarterly.org/index.php?pg=content

Aslan, S. (2015). Is learning by teaching effective in gaining 21st century skills: The views of pre-service science teachers. *Educational Sciences Theory and Practice*, *15*(6), 1441-1457. http://dx.doi.org/10.12738/estp.2016.1.019

Bloomberg, L. D., & Volpe, M. (2012). *Completing your qualitative dissertation: A road map from beginning to end* (2 ed.). Thousand Oaks, CA: SAGE.

Boaler, J. (2006). How a detracked mathematics approach promoted respect, responsibility, and high achievement. *Theory into Practice*, *45*(1), 40-46. http://dx.doi.org/10.1207/s15430421tip4501_6

Bolkan, J. (2016). NWEA aligns MAP for science with next generation standards. Retrieved from https://thejournal.com/articles/2016/11/08/nwea-aligns-map-for-science-with-next-generation-standards.aspx

Bower, H. A., & Parsons, E. R. (2016, October 19th). Teacher identity and reform: Intersections within school culture. *Urban Review, 48 (5)*, 743-765. https://doi.org/10.1007/s11256-016-0376-7

Brooks, K., & Thurston, L. (2010). English language learner academic engagement and instructional grouping configurations. *American Secondary Education, 39*(1), 45-60. Retrieved from http://www.jstor.org/stable/41406182

Broussard, A. C. (1998). Tracking: A form of educational neglect. *Social Work in Education* , *20*(2), 110-120. https://doi.org/10.1093/cs/20.2.110

Cate, I., Schwerdt, S., & Glock, S. (2016). Accuracy of teachers' tracking decisions: Short- and long-term effects of accountability. *European Journal Of Psychology of Education, 31 (2),* 225-243. https://doi.org/10.1007/s10212-015-0259-4

Coupal, L. (2004). Constructivist learning theory and human capital theory: Shifting political and educational frameworks for teachers' ICT professional development. *British Journal of Educational Technology*., *35*(5), 587-596. http://dx.doi.org/10.1111/j.0007-1013.2004.00415.x

Creswell, J. W. (2013). *Qualitative inquiry and research design* (3rd ed.). Thousand Oaks, CA: SAGE.

Edwards, F., & Edwards, R. (2017). A story of culture and teaching: the complexity of teacher identity formation. *The Curriculum Journal*, *28*(2), 190-211. http://dx.doi.org/10.1080/09585176.2016.1232200

Foldnes, N. (2016). The flipped classroom and cooperative learning: Evidence from a randomized experiment. *Active Learning in Higher Education*, *17*(1), 39-49. https://doi.org/10.1177/1469787415616726

Francis, B., Archer, L., Hodgen, J., Pepper, D., Taylor, B., & Travers, M. (2017). Exploring the relative lack of impact of research on 'ability grouping' in England: A discourse analytic

account. *Cambridge Journal of Education, 47*(1), 1-17. http://dx.doi.org/10.1080/0305764X.2015.1093095

Gagnon, G. W., & Collay, M. (2001). *Designing for learning: Six elements in constructivist classrooms*. Thousand Oaks, CA: Corwin Press, Inc.

Gardner, H. (2011). *Frames of mind: The theory of multiple intelligences* (3rd ed.). Retrieved from http://www.ebrary.com

Gonzalez, A., Peters, M., Orange, A., & Grigsby, B. (2017). The influence of high-stakes testing on teacher self-efficacy and job-related stress. *Cambridge Journal of Education, 47*(4), 513-531. https://doi.org/10.1080/0305764X.2016.1214237

Gray, J., Kruse, S., & Tarter, C. J. (2016). Enabling school structures, collegial trust and academic emphasis: Antecedents of professional learning communities. *Educational Management Administration & Leadership*, *44*(6), 875-891. http://dx.doi.org/10.1177/1741143215574505

Guglielmi, D., Bruni, I., Simbula, S., Fraccaroli, F., & DePolo, M. (2015). What drives teacher engagement: A study of different age cohorts. *European Journal of Psychology and Education , 31*(3), 323-340. https://doi.org/10.1007/s10212-015-0263-8

Gulpinar, M., Isoglu-Alkac, U., & Yegen, B. (2015). Integrated and contextual basic science instruction in preclinical education: Problem-based learning experience enriched with brain/mind learning principles. *Educational Sciences: Theory & Practice, 15(*5), 1215-1228. http://dx.doi.org/ 10.12738/estp.2015.5.0095

Hall, A., & Miro, D. (2016). A study of student engagement in project-based learning across multiple approaches to STEM education programs. *School Science and Mathematics*, *116*(6), 310-319. http://dx.doi.org/10.1111/ssm.12182

Hallam, S., & Ireson, J. (2007). Secondary school pupils' satisfaction with their ability grouping placements. *British Educational Research Journal, 33*(1), 27-45. http://dx.doi.org/10.1080/01411920601104342

Hallo, A., & Hirn, R. (2015). Teacher and student behaviors in the contexts of grade-level and instructional grouping. *Preventing School Failure, 59*(1), 30-39. http://dx.doi.org/10.1080/1045988X.2014.919140

Harmer, N., & Stokes, A. (2016). "Choice may not necessarily be a good thing": Student attitudes to autonomy in interdisciplinary project-based learning in GEES disciplines. *Journal of Geography in Higher Education, 40*(1), 531-545. http://dx.doi.org/10.1080/03098265.2016.1174817

Helou, M., Nabhani, M., & Bahous, R. (2016). Teachers' views on causes leading to their burnout. *School Leadership & Management, 36*(5), 551-567. https://doi.org/10.1080/13632434.2016.1247051

Hornby, G., Witte, C., & Mitchell, D. (2011). Policies and practices of ability grouping in New Zealand intermediate schools. *Support For Learning, 26*(3), 92-96. http://dx.doi.org/10.1111/j.1467-9604.2011.01485.x

Hu, S., Makel, M., & Kubilius, P. (2016). What one hundred years of research says about the effects of ability grouping and acceleration on K–12 students' academic achievement: Findings of two second-order meta-analyses. *Review of Educational Research , 86*, 849-899. https://doi.org/10.3102/0034654316675417

Hyland, A. (2011). Multiple intelligences: Curriculum and assessment project. *Final Report.* Retrieved from http://www.eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED538017

Jennings, P. A. (2017). Impacts of the CARE for teachers program on teachers' social and emotional competence and classroom interactions. *Journal of Educational Psychology, 109*(7), 1010-1028. Retrieved from http://dx.doi.org/10.1037/edu0000187.supp

Jurkowski, S., & Hanze, M. (2015). How to increase the benefits of cooperation: Effects of training in transactive communication on cooperative learning. *British Journal of Educational Psychology, 85*(3), 357-371. http://dx.doi.org/10.1111/bjep.12077

Kapusnick, R., & Hauslein, C. (2001). The 'silver cup' of differentiated instruction. *Kappa Delta Pi Record, 37*(4), 156-159. http://dx.doi.org/10.1080/00228958.2001.10518493

Karlson, K. (2015). Expectations on track: High school tracking and adolescent educational expectations. *Social Forces, 94*(1), 115-141. http://dx.doi.org/10.1093/sf/sov006

Kaya, S. (2015). The effect of the type of achievement grouping on students' question generation in science. *The Australian Association for Research in Education, 42*(1), 429-441. http://dx.doi.org/10.1007/s13384-014-0164-x

Kim, Y. (2012). Implementing ability grouping in EFL contexts: Perceptions of teachers and students. *Language Teaching Research, 16*(3), 289 –315. http://dx.doi.org/10.1177/1362168812436894

Klapproth, F. (2015). Do algorithms homogenize students' achievements in secondary school better than teachers' tracking decisions? *Education Policy Analysis Archives, 23*(62), 1-21. http://dx.doi.org/http://dx.doi.org/10.14507/epaa.v23.2007

Kloser, M., Borko, H., Martinez, J., Stecher, B., & Luskin, R. (2016). Evidence of middle school science assessment practice from classroom-based portfolio. *Science Education 101*(2), 209-231. https://doi.org/10.1002/sce.21256

Larson, L. C., & Miller, T. N. (2012). 21st century skills: Prepare students for the future. *Kappa Delta Pi Record, 47*(3), 121-123. http://dx.doi.org/10.1080/00228958.2011.10516575

Lee, O., Miller, E., & Januszyk, R. (2014). Next generation science standards: All standards, all students. *Journal of Science Teacher Education, 25(2),* 223-233. https://doi.org/http://dx.doi.org.une.idm.oclc.org/10.1007/s10972-014-9379-y

Leshkovska, E. A., & Spaseva, S. M. (2016). John Dewey's educational theory and educational implications of Howard Gardner's . *International Journal of Cognitive Research in Science, Engineering & Education, 4*(2), 57-66. http://dx.doi.org/10.5937/IJCRSEE1602057A

Lippman, P. C. (2015). Designing collaborative spaces for schools. *Education Digest*, 39-44. Retrieved from http://thejournal.com/research/2013/02/magazine_february.aspx?tc=page0

Lotan, R. (2006). Teaching teachers to build equitable classrooms. *Theory Into Practice, 45*(1), 32-45. http://dx.doi.org/10.1207/s15430421tip4501_5

Macqueen, S. (2013). Grouping for inequity. *International Journal of Inclusive Education, 17*(3), 295-309. http://dx.doi.org/http://dx.doi.org/10.1080/13603116.2012.676088

McFarlane, D. (2011). Multiple intelligences: The most effective platform for global 21st century educational and instructional methodologies. *College Quarterly, 14*(2), 1-8. Retrieved from http://files.eric.ed.gov/fulltext/EJ962362.pdf

Missett, T. C., Brunner, M. M., Callahan, C. M., Moon, T. R., & Azano, A. P. (2014). Exploring teacher beliefs and use of acceleration, ability grouping, and formative assessment. *Journal for the Education of the Gifted , 37*(3), 245-268. http://dx.doi.org/ 10.1177/0162353214541326

Muller, L., Isely, P., & Levin, A. (2015, January 1st , 2015). Healthcare Reform Lookback. *Benefits Quarterly*, 51-63. Retrieved from http://web.b.ebscohost.com.une.idm.oclc.org/ehost/pdfviewer/pdfviewer?sid=4e5feb8c-1210-4681-aa47-f5987120c201%40sessionmgr111&vid=5&hid=123

Park, V. (2017). Ability grouping and differentiated instruction in an era of data-driven decision making. *American Journal of Education, 123*(2). Retrieved from http://www.journals.uchicago.edu.une.idm.oclc.org/doi/abs/10.1086/689930

Pennington, M. (2010, February 15th, 2010). 23 myths of differentiated instruction [Blog post]. Retrieved from http://blog.penningtonpublishing.com/reading/23-myths-of-differentiated-instruction/

Penuel, W. R., Harris, C. J., & Haydel, A. (2015). Implementing the next generation science standards. *Phi Delta Kappan*, *96*(6), 45-49. Retrieved from kappanmagazine.org

Pepper, C. (2010). There's a lot of learning going on but not much teaching!: Student perceptions of Problem-Based Learning in science. *Higher Education Research & Development*, *29*(6), 693-707. http://dx.doi.org/10.1080/07294360.2010.501073

Pit-ten Cate, I. M., Schwerd, S. K., & Glock, S. (2016). Accuracy of teachers' tracking decisions: short- and long-term effects of accountability. *European Journal of Psychology of Education*, *31*(2), 225-243. http://dx.doi.org/10.1007/s10212-015-0259-4

Preckel, F., & Brull, M. (2008). Grouping the gifted and talented: Are gifted girls most likely to suffer the consequences? *Journal for the Education of the Gifted*, *32*(1), 54-85. Retrieved from http://jeg.sagepub.com.une.idm.oclc.org/content/by/year

Prilleltensky, I., Neff, M., & Bessell, A. (2016). Teacher stress: What it is, why it's important, how it can be alleviated. *Theory Into Practice, 55*(1), 104-111. https://doi.org/10.1080/00405841.2016.1148986

Rabin, C. (2013). Care through authenticity: Teacher preparation for an ethic of care in an age of accountability. *The Educational Forum, 77*(3), 242-255. http://dx.doi.org/10.1080/00131725.2013.792904

Rabin, C., & Smith, G. (2013). Teaching care ethics: Conceptual understandings and stories for learning. *Journal of Moral Education*, *42*(3), 164-176. http://dx.doi.org/http://dx.doi.org/10.1080/03057240.2013.785942

Richards, J. (2012). Teacher stress and coping strategies: A national snapshot. *The Educational Forum* , *76*(3), 299-316. https://doi.org/10.1080/00131725.2012.682837

Rowcliffe, S. (2006). The future of student groupings systems in science 14-16. *The Science Education Review, 5*(3), 87-94. Retrieved from http://www.eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=EJ1057131

Sencibaugh, J., & Sencibaugh, A. (2016). An analysis of cooperative learning approaches for students with learning disabilities. *Education*, *136*(3), 356-364. Retrieved from http://web.a.ebscohost.com.

Sparks, S. (2012). Panel parses out skills needed for 21st-century workplace. *Education Week, 31*(36), 7. Retrieved from http://web.a.ebscohost.com

Stroupe, D. (2015). Describing "science practice" in learning settings. *Science Education, 99*(6), 1033-1040. http://dx.doi.org/10.1002/sce.21191

Tlhoaele, M., Suhre, C., & Hofman, A. (2016). Using technology-enhanced, cooperative, group-project learning for student comprehension and academic performance. *European*

Journal of Engineering Education, 41(3), 263-278. https://doi.org/10.1080/03043797.2015.1056102

Tobin, R., & Tippett, C. D. (2013, March 4). Possibilities and potential barriers: Learning to plan for differentiated instruction in elementary science. *International Journal of Science and Mathematics Education, 12*(2), 423-443. http://dx.doi.org/http://dx.doi.org.une.idm.oclc.org/10.1007/s10763-013-9414-z

Valdmann, A., Holbrook, J., & Rannikmae, M. (2017). Determining the effectiveness of a design-based, continuous professional development programme for science teachers. *Journal of Baltic Science Education, 16(4),* 576-591. Retrieved from http://www.jbse.webinfo.lt

Vogel, L. (2012). A leader's journey: The challenges of implementing standards-based student grouping. *NASSP Bulletin, 96(4*), 323-349. http://dx.doi.org/10.1177/0192636512467675

Vogl, K., & Preckel, F. (2014). Full-time ability grouping of gifted students: Impacts on social self-concept and school-related attitudes. *Gifted Child Quarterly, 58*(1), 51-68. http://dx.doi.org/10.1177/0016986213513795

Watanabe, M., Nunes, N., Mebane, S., Scalise, K., & Claesgens, J. (2007). Chemistry for all, instead of chemistry just for the elite: Lessons learned from detracked chemistry classrooms. *Science Education, 91*(5), 683-709. http://dx.doi.org/10.1002/sce.20213

Worthy, J. (2010). Only the names have been changed: Ability grouping revisited. *Urban Review, 42*(4), 271-295. http://dx.doi.org/10.1007/s11256-009-0134-1

Yonezawa, S., & Jones, M. (2006). Students' perspectives on tracking and detracking. *Theory into Practice, 45*(1), 15-23. http://dx.doi.org/10.1207/s15430421tip4501_3.

Young, M. H., & Balli, S. J. (2014). Gifted and talented education (GATE). *Gifted Child Today*, 37*(4)*, 236-246. https://doi.org/10,1177/1076217514544030

Zane, T. (2009). Performance assessment design principles gleaned from constructivist learning theory (Part 1) . *TechTrends: Linking Research & Practice to Improve Learning*, *53*(1), 81-90. http://dx.doi.org/10.1007/s11528-009-0242-5