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Improving Kindergartener's Initiative to Problem Solve Through Integrated STEM

Jessica Walston
University of Nebraska-Lincoln, jeswalston@gmail.com

Improving Kindergartener's Initiative to Problem Solve

Through Integrated STEM

by

Jessica Walston

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IMPROVING KINDERGARTENER'S INITIATIVE TO PROBLEM SOLVE

THROUGH INTEGRATED STEM

Jessica Walston, M.A.

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Advisor: Amanda Thomas

Many teachers are familiar with students who are scared to try to solve a problem and instead look to adults for specific answers. Students need to be prepared to solve problems independently and collaboratively. One of the necessary skills to solve a problem is to first try, or take *initiative*. The purpose of this action research was to identify Kindergarten students' initial initiative to problem solve by formal evaluation of student learning-related skills, taken from the Cooper-Farran Behavioral Rating Scale (1991). In this study, students were provided opportunities to take the initiative to problem solve through a series of integrated STEM and Habits of Mind lessons. The students were then observed during the lessons. These observations helped the teacher to prepare appropriate lessons and evaluate students on their learning-related skills. This research suggests that, when a student shows a high level of personal interest in an integrated STEM topic or Habits of Mind lesson, they are more motivated to take the initiative to problem solve. Students were also more likely to participate and persevere through a task when their interest was piqued. Teachers could use students' personal interests in STEM education as a strategy for supporting future success.

Keywords: Kindergarten, initiative, integrated STEM, Habits of Mind

DEDICATION

While many family, friends, co-workers, students, and school families deserve to be given credit for all that they have done in an effort to complete this study, I dedicate my work here to my son Christopher Ray Walston. He was always curious, asked “Why?’, attempted to try new things, and took the initiative to solve real-world problems. He will forever be my Scientist, Technophile, Engineer, and Mathematician.

GRANT INFORMATION

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CHAPTER 1: INTRODUCTION

Problem Statement

With the nationwide focus from policymakers, industry, and education on integrated Science, Technology, Engineering and Mathematics education (STEM), it is important to study the effects of integrated STEM on learning-related skills. For the purposes of this study, integrated STEM is defined as the integration of any two or more STEM subjects during a given lesson. This study specifically looks at the relationship between integrated STEM and Kindergarten students' initiative to problem-solve. The ability to take initiative and try to solve a problem is an important skill to utilize in the process of integrated STEM. Initiative is directly evident in the learning-related skills of: self-control, staying on task, and working independently.

In informal observations of past students, I have noticed that when presented with a problem, early childhood students often lack the confidence to try to solve a problem. In other words, they lack the initiative to begin the problem-solving process. Many times students complain that they can't solve a problem or a problem is just too hard. Integrated STEM lessons were incorporated in the classroom, in an effort to motivate students through their personal interests and encourage their initiative to problem solve. As an added practice to problem solving, students were also provided classroom opportunities to practice Habits of Mind (HoM). According to Marzano (1992) and Costa and Kallick (2000), students who develop these HoM are expected to have future academic, relationship, and employment success. HoM have cross-curricular value and therefore, will be useful in completion of integrated STEM projects.

Purpose and Research Questions

The purpose of this study was to answer the following question: When integrated STEM education is introduced in Kindergarten, what are the outcomes on student's initiative to problem solve?

Methods Overview

A case study was conducted during a nineteen week period in the teacher's regular education Kindergarten classroom. The teacher implemented integrated STEM, Habits of Mind (HoM), and problem solving lessons to engage students in problem solving tasks. The teacher monitored students through a series of formal and informal observations, initial and final interviews, student artifacts, and a professional teacher's journal. Students were formally observed every third week to keep a record of changes in student initiative during integrated STEM and HoM lessons. After observations, three students were chosen for analysis based on their initial initiative ratings.

Definition of Key Terms

Habits of Mind: "ways of thinking that one acquires so well, makes so natural, and incorporates so fully into one's repertoire, that they become mental habits – not only can one draw on them easily, one is likely to do so" (Goldenberg, 1996, p. 14)

Initiative: the motivation to begin a task, evident in the learning-related skills of: self-control, staying on task, and working independently

Integrated STEM: the integration of any two or more of the following subjects: Science, Technology, Engineering, or Mathematics during a given lesson

Learning-related skills: self-control, stay on task, organize work materials, work independently, listen to and follow directions, and participate in groups appropriately (Cooper & Farran, 1991)

CHAPTER 2: LITERATURE REVIEW

Overview

Effective educators are always looking for ways to improve their teaching in the classroom. The following review of literature confirms the importance of teaching integrated STEM education in the early childhood classroom to develop learning-related skills that will increase future educational, relational, and job-related success. Below is a literature review of the following: a) why integrated STEM is a best practice for early childhood education, b) best practices for integrating STEM education, c) the importance of Habits of Mind, and d) the effect integrated STEM education can have on future success.

Integrated STEM as a Best Practice

In order to begin working with early childhood students, it is first important to understand that early childhood students are set apart from all the rest due to their development, and so one should note best practices and strategies for an early childhood classroom. Moomaw made an effort to show parents and educators how integrated "STEM learning begins at birth!" (2016, p. 237) She described how children are motivated to do things that interest them, like making a tower out of blocks (engineering), feeding baby dolls (mathematics), and bath-time (scientific-inquiry). All of these are STEM related learning opportunities. It is innate in children to be curious and look for answers. Therefore, teachers could use this curiosity to motivate a child in their formal schooling experience. It is possible, that the motivation infants and toddlers have to complete an action, can be replicated in pre-school and Kindergarten classrooms if students are given the opportunity to direct their own learning. Moomaw (2016) advocated for integrated STEM opportunities and standards for infants through the first five years of their life, when much neurological development happens. A longitudinal study by Duncan, Dowsett, Claessens, Magnuson, Huston, Klebanov, and Sexton (2007) suggested that children's mathematical development at the time of school entry is the strongest predictor of later academic success. Therefore, when children have been provided quality learning opportunities as infants and toddlers, they are more likely to succeed later in life. The article suggests integrated STEM is not only a best practice for early childhood education but it is the students' way of understanding the natural world from birth.

Author Katz (2010) suggested a best practice for early childhood education is Project Approach learning. Katz (2010) suggested academic skills should be mastered through Project Approach learning. The author states "appropriate curriculum in the early childhood years is one that encourages and motivates children to seek mastery of basic academic skills in the service of their intellectual pursuits" (Katz, 2010, para. 5). This approach encourages students to learn new skills, so that they can answer their own inquiry. Students are more motivated when answering their own inquiry. The approach and motivation Katz (2010) describes might also be defined as, initiative. Project Approach learning is similar to what other researchers call, Project-Based Learning (PBL), where students use cross-curricular concepts to solve real-world problems in collaborative groups (Berry, Chalmers, & Chandra, 2012). Integrated STEM education is PBL with a specific focus on science, technology, engineering, and mathematics.

Tippett and Milford (2017) found that when students are actively engaged in STEM based-learning opportunities, STEM is an appropriate component of early childhood education. The authors developed a classroom observation protocol based on "questioning, play, processes skills, and scientific and engineering practices" appropriate to educational experiences in early childhood (Tippet & Milford, 2017, p. S82). Data collected from multiple stakeholders: students, early childhood educators, and parents provided "evidence for the appropriateness of STEM at the Pre-K level." (Tippet & Milford, 2017, p. S82) Therefore, their research supports the inclusion of integrated STEM in early childhood classrooms.

Implementation of Integrated STEM

While it is important to know the best practice for educating early-childhood students and preparing them for future education, it is also important to understand the best methods for implementing those practices. Honey, Pearson, and Schweingruber (2014), define a general higher-level framework of STEM education in the book *STEM Integration in K-12 Education: Status, Prospects, and an Agenda for Research*. The framework is made of the following four features: goals, outcomes, nature and scope of integration, and implementation. They specifically identify "interest and engagement" as a goal and "educational persistence" as an outcome of STEM education. (Honey, Pearson, & Schweingruber, 2014, p. 35 & 38). When students are interested in a topic, their initiative to begin problem solving is higher and they are more engaged in working to find a solution and will persist through difficulties. Research is needed to gain insight as to whether or not integrated STEM education is meeting the goals and outcomes outlined.

The project-based learning (PBL) approach "is a learner-centered approach where students are encouraged to integrate knowledge, take responsibility for their learning and work in teams to investigate real issues and construct products" (Berry, Chalmers, & Chandra, 2012, p. 226). PBL is highly motivating for students due to the relationship to real-world applications. Three models are suggested for implementation of PBL. First, the Central Project Approach led by the teacher who integrates STEM subjects around a shared problem or design task. Second, the Student Led Project Approach. In this approach students are to design a project of their own and apply a range of STEM subjects to the development of their project. Third, Using Student Led Projects as the Curriculum involves students suggesting a design project which the teacher then connects to the learning outcomes expected within a range of STEM subjects (Berry, Chalmers, & Chandra, 2012). Each of the PBL approaches has strengths and weaknesses which are necessary to understand and consider when developing integrated STEM lessons for the classroom. The authors conclude that the key to maintaining student interest and motivation throughout the project within all of the approaches, is to keep the project connected to real-world problems and open to new ideas.

In an additional study by Carroll, Goldman, Britos, Koh, Royalty, and Hornstein (2010), design thinking was researched in a middle school classroom to learn more about how to use design thinking in K-12 classrooms. In recent years, a shift of educational practices has moved from a teacher-directed approach to a student-directed approach that requires students to be innovative, creative, and think critically. Key components of the design process include (1) human-centered (2) action-oriented and (3) mindful of process. (Carroll, et al.., 2010; Hasso Plattner Institute of Design at Stanford, 2007). Like, integrated STEM and PBL, design thinking can be used in all content areas and to develop learning-related skills. Carroll, et al. (2010) suggests that design thinking: should be used to improve classroom instruction, must be integrated into academic content, impacts how students engage and take risks with their learning, is collaborative, forces students to be aware of where they are in the learning process, and provides new ways of thinking for both teacher instruction and student learning. This study verifies that integrated STEM, PBL, and the design thinking are all connected and are meaningful practices to incorporate and use in the classroom. The study was limited to middle school use and more research is necessary to look at the effect at an early childhood level.

Sun (2018) addressed the question: How might mathematics teachers convey mindset messages related to mathematics ability in their classroom? Mathematics is an important component to integrated STEM education. Through qualitative research, the Math Teaching for Mindset Framework (MTMF) was developed to highlight practices that convey a fixed- or growth-mindset. The framework includes four categories: a) Sorting: How students are grouped; b) Norm Setting: Explicit mindset messaging and handling mistakes; c) Engaging in Mathematics: What tasks the teacher places emphasis on during instruction and how instruction is delivered; and d) Giving Feedback and Assessing: The type of verbal feedback given, grading policies, and availability of after school help (Sun, 2018). The research concluded that the mathematical instruction most likely to convey growth-mindset messages is intricately linked to multidimensional engagement in mathematics. Sun (2018) highlighted examples of two educators on opposite ends of the mindset continuum, which helped to identify specific practices to use in research to convey a growth-mindset. By having teachers who convey a growth-mindset, students will be more likely to use learning-related skills that inspire initiative to problem solve. The MTMF developed serves as an important tool to use in the classroom while attempting to integrate STEM education and develop a growth-mindset for students, not just in mathematics but cross-curricular.

Importance of Habits of Mind

Habits of Mind are critical thinking skills often associated with, but not limited to specific content areas. Many HoM can be used across the classroom curriculum in an effort to develop skills within students for future academic, social, and job-related success. Habits of Mind are defined differently by different researchers and content area specialists, but have the common theme: ones' ability to draw on and use the skills at the appropriate time, in conjunction with other skills to successfully solve a problem.

In the article, *Theorising Habits of Mind as a Framework for Learning*, Campbell (2006) reviews literature in an effort to connect HoM with the nature of intelligence, cognitive learning theories, social learning theories, and brain research. He draws upon Costa and Kallick's (2000) definition, "Habits of Mind (HoM) are claimed to be intelligent thinking behaviors used by peak performers to solve problems and organize learning within vocational, relational, or academic settings" (Campbell, 2006, p.1). Sixteen HoM were characterized of peak performers, some are listed here: persisting, managing impulsivity, metacognition, thinking flexibly, striving for accuracy, questioning and problem posing, thinking and communicating with clarity and precision, creating, imagining and innovating, and thinking interdependently (Campbell, 2006). When students use skills like questioning and problem posing they find intrinsic value in their own learning which increases their initiative to problem solving. Campbell claims "By its very nature the HoM framework focusses attention on the process and strategies that students' minds need to engage with for effective learning to occur" (2006, p.4). This suggests HoM skills are necessary to engagement and learning in all settings, including integrated STEM. In Campbell's review of the nature of intelligence, cognitive and social learning theories, and recent brain research he made connections to the HoM. He proposes "HoM as a potentially useful learning framework relevant to contemporary understandings of teaching and learning" (Campbell, 2006, p. 14).

Goldenberg (1996) defines Habits of Mind as "ways of thinking that one acquires so well, makes so natural, and incorporates so fully into one's repertoire, that they become mental habits – not only can one draw on them easily, one is likely to do so" (p. 14). His article specifically approaches HoM as a way to organize mathematics curriculum in an effort to make "Mathematics for All". Rather than separating mathematics courses into those who can and those who can cannot or reducing mathematics to what is core for everyone, Goldenberg suggests teaching mathematics HoM alongside mathematics content. He suggests that "mathematics is not about the facts, it is about the reasoning that finds and assembles and makes sense out of the facts: mathematics is (in part) a way of thinking, a set of 'habits of mind'" (Goldberg, 1996, p.20). No longer is there just one correct way to find an answer. Instead, through the use of HoM, there are many correct ways to reach a desired answer or goal, whether it be in mathematics or other content areas.

While there are many definitions to HoM, authors Campbell (2006) and Goldberger (1996) suggest that by developing these critical thinking skills students will be more successful in all content areas, relationships, and the future workplace. Through Project Based Learning, it is reasonable that students might draw on Habits of Mind to achieve a goal. When learning through the integrated STEM approach, students must persist, think about their thinking (metacognition), communicate clearly, and be creative; just to name a few. There is a dearth of research around HoM and integrated STEM, together.

Future Educational Success

If teachers are to implement integrated STEM and HoM into the early childhood classroom, we should take a look at the impact these methods will have on students' future success. Students who have developed a growth mindset and are inclined to take initiative may have continued educational success as illustrated by Marcon's research in 2002. Marcon (2002) examined follow-up data for a group of low-income, minority children who had attended preschool and Kindergarten, prior to first grade. Three different preschool models were used: child-initiated, academically directed, and a "combination" approach. While initial research showed no difference, by the end of year 6, students in child-initiated preschool were starting to move ahead of their peers. As mentioned previously, integrated STEM is child-initiated by nature and therefore introducing STEM at a young age may also give students an academic advantage in later years.

Further research from McClelland, Acock, and Morrison (2006) reports that a child's learning-related skills can indicate academic success in elementary school, suggesting a need for interventions of learning-related skills in early childhood classrooms. In this study, learning-related skills were assessed using the Cooper-Farran Behavioral Rating Scale (Cooper & Farran, 1991). Some of these skills include: self-control, stay on task, organize work materials, work independently, listen to and follow directions, and participate in groups appropriately. When these skills are drawn upon and used in conjunction with one another, student initiative can be assessed. These studies validate the need for child-initiated classroom models in early childhood education and support the need for interventions in learning-related skills at a Kindergarten level. Because integrated STEM education is child-initiated and can act as an intervention to learning-related skills, it stands out as a best practice to support future success.

Researchers Becker and Park (2011) reveal a positive effect on student learning when teachers take an integrated STEM approach to teaching. Their study determined the effect size of integrated lessons for two or more STEM subjects. The greatest effect size for achievement was produced when all STEM subjects were integrated into a lesson. “Students who were exposed to integrative approaches demonstrated greater achievement in STEM subjects” (Becker, 2011, p.31). However, it is difficult to integrate every STEM subject into every lesson. This study suggests that exposure to integrated STEM in early childhood education could produce even higher achievement in STEM subjects as students continue through elementary school. Longitudinal studies need to be completed to assess effects on future success.

In research conducted by Noel and Liub (2017) it is suggested that design-based education increases student engagement and future success. As mentioned before, integrated STEM, PBL, and Design Thinking have similarities and can work well together to form a framework for teaching. Noel and Liub (2017) reference learning-related skills and HoM taught through design-based learning that play an even greater role in preparing students for future success than academic content. It is important to note that design-based learning promotes curiosity and therefore engages students in their learning. This could also be perceived as the initiative to work on a project or lesson. If students are exposed to the design process, where curiosity is valued, students will have also been exposed to HoM that are geared toward future success.

Summary

Having reviewed the above literature, it seems imperative to the future of education to include integrated STEM and Habits of Mind in the early childhood classroom as a means to develop learning-related skills. Teachers need to be aware of best practices for implementation that produce the greatest success rates. The development of learning-related skills, such as the ability to take initiative to begin a task, will only prove to develop the student as a whole, and encourage future success in educational, relational, and employment opportunities. “Appropriate STEM experiences in early childhood can be starting points for supporting children’s continued successes in STEM at the elementary, secondary, and post-secondary levels.” (Tippett & Milford, 2017, p. S68)

CHAPTER 3: METHODS

Overview

I conducted action research in my Kindergarten classroom using a case study design focused on three students. A series of interviews, formal and informal observations, and artifacts of student work were utilized to determine the students' initial initiative rating and initiative ratings throughout the study. I implemented integrated STEM and Habits of Mind lessons to engage students in problems solving tasks.

Integrated STEM lessons were designed by the teacher or chosen from the book *Steam Design Challenges, Gr. K*. by Powers, Barenborg, Sexton, and Monroe (2017). Using the Central Project Approach as studied by Berry, Chalmers, and Chandra (2012), the teacher taught content, background knowledge, and literacy connections prior to introducing a dilemma. The Central Project Approach was chosen because it is the most teacher controlled approach, yet allows student individuality in project designs and solution. Students were expected to follow a design process:

1. Individual Blueprint
2. Group Blueprint
3. Create
4. Test
5. Redesign
6. Journal Reflection

Due to classroom time constraints, the teacher occasionally chose to expedite the process by eliminating individual blueprints or redesign. A brief description of the integrated STEM lessons taught can be seen in Table 1.

Table 1

Integrated STEM Lesson Descriptions

Lesson	Description
The three men have a leaky tub	Create a flotation device for one of the three men in a leaky tub.
Home for a wild thing	Create a shoebox habitat for a wild thing and include the resources it would need to survive.
100th Day	Create a vertical number 100 using 100 of the same material.
Bear is lost	Design a map of Bear's home and his surroundings.
Chicka chicka boom boom	Design and construct a letter or number that stands on its own.
Swine shelter	Build a model of a house that is protected from a dangerous flood.
3D jelly bean shapes	Build 3 dimensional shape models.

Habits of Mind (HoM) lessons were drawn from multiple resources and focused primarily on problem solving within the content area of mathematics. These lessons were completed through whole group discussion, small group collaboration, and/or individual discovery. A brief description of the HoM lessons can be seen in Table 2.

Table 2

HOM Lesson Descriptions

Lesson	Description
Tic Tac Math	Determine the missing numbers on a tic tac toe board so that all rows, columns, and three numeral diagonals add up to the same sum.
Ages Chart	Use the chart and provided child information to determine each child's age.
Combing Cubes	Use the provided visual shapes to determine which pre-made shapes can be formed.
Frogs on a Log	Use visual comparisons to determine more and less.
Balance Benders	Use the scale to understand value relationships between shapes. Then, determine if algorithmic sentences are true or false. Explain your thinking.
Farmer's Pen	Make a model to answer the following: A farmer has chickens and cows in a pen. The animals have 10 legs altogether. How many cows are in the pen? How many chickens are in the pen?
Jumping Frogs	Describe what you see in the picture. Use that information to tell "How many frogs are in the water?"
Pattern Block Puzzle	Organize pattern blocks on the table so that only one of each shape is in each column and row.

Note: Lessons were drawn or adapted from www.criticalthinking.com

Context of the Study

This research took place in a small, rural community in central Nebraska with a population of 24,907 people. There are seven elementary schools in the area. The study was completed at the Catholic elementary school. Grades Pre-Kindergarten through Fifth Grade students are served in this elementary school. There are two sections of each grade level. Students who attend the private school are predominantly Catholic. All of the operating funds for the school come from tuition, fundraising, and parish support.

Support staff is mostly available on a volunteer level, with the exception of one full time paraprofessional.

For this study, the researcher is the Kindergarten teacher in the classroom where the research is taking place. I hold a Bachelor of Science in Elementary Education degree with an endorsement in Early Childhood Education. I am currently studying at the University of Nebraska at Lincoln, where I will complete a master's degree in Teaching and Learning with an emphasis in STEM education. I have fourteen years of teaching experience, thirteen of those years are specific to early childhood education. I also have prior experience working in a child care and development facility with infants and toddlers. I have been a regular education teacher at the research site for twelve years.

Participants

The research took place in one regular education Kindergarten classroom. There were thirteen students in the classroom, six were male and seven were female. Twelve of the students attended the pre-Kindergarten classes offered at the elementary school site. The students have a varied background of one to three years in the pre-Kindergarten classes. All students participated in the lessons associated with this study during regular school hours.

After the study was complete, three students, Tanya, Thayer, and Aaron, were chosen for specific analysis. Their families consented to their participation in this study. The three students are all raised in nuclear families with working parents. All student names used are pseudonyms. Tanya is a girl age 6. Thayer and Aaron are boys age 6. Although the selected students performed similarly well in all Kindergarten academic areas and carried positive peer relationships throughout the school year, an initial evaluation of the students' rate of initiative showed three distinct ratings of initiative. The students were chosen because they scored in three different initiative ratings. Tanya was chosen because the initial evaluation indicated she was proficient in using all of the learning-related skills related to initiative. In Thayer's initial evaluation, he did not exhibit the use of any learning-related skills and received a beginning rating of initiative. Aaron's initial evaluation showed he was proficient in using all of the learning-related skills but, was inconsistent in doing so, therefor he rated progressing.

Data Collection

Data were collected over a nineteen-week period from January 2019 – May 2019. I collected data through the following sources: student interviews, formal and informal student observations, student artifacts, and my professional teacher's journal. A schedule of data collected is reflected in Table 3.

Table 3

Data Collected from Case Studies

Data Source	Frequency of Data Collection
Student Interviews	Beginning and end of semester
Individual student observations	Tri-weekly
Student Work	Completion of each lesson
Professional Teacher Journal	Weekly

Student Interviews

All students were interviewed twice during the study. The first interviews were in February after having been exposed to and having completed one integrated STEM lesson. The final interviews were conducted in May. The interview questions used are located in Appendix A. Students were allowed to respond to the interview questions as yes, no, or sometimes. Then they were also asked to explain their answer choice.

Student Observations

All thirteen students were formally observed every third week from January 2019 through April 2019. A Student Observation Matrix was created based on the learning-related skills from the Cooper-Farran Behavior Rating Scale (1991). Learning-related skills observed include: does the student use self-control, stay on task, organize work materials, work independently, listen to and follow directions, and participate in groups appropriately. For the purposes of this study, these skills were operationalized as described in Table 4.

Each observation was a five-minute snapshot of the student's abilities during the integrated STEM or HoM lesson. The observation matrix was coded "+" if the student did exhibit the skill or "-" if the student did not use or was inconsistent in using the skill. When the skill was not applicable to the lesson, the skill was then coded "na". The observation matrix can be found in Appendix B.

Additional informal observations were recorded throughout the study and kept in the teacher's professional journal. These were recorded at random. The teacher recorded student behaviors, comments, participation in lessons, and information regarding the process used in student groups to reach a finished design or solution to a problem.

Table 4

Learning-related Skills Operationalized

Learning-Related Skill	Observable Operations
Using self-control	Student stays in control of body at workspace
Staying on task	Student works on lesson continuously, either through conversation or hands on
Organizing work materials	Student keeps materials neat, within the student's workspace, and uses materials appropriately
Working independently	Student works on the task without reminders from peers or the teacher; either during individual work or group work
Listening and following directions	Student is attentive to directions and does what was asked
Participating appropriately in groups	Student is an active participant in group work and works to achieve a common group goal

Student Artifacts

Student work was collected after each integrated STEM lesson was complete and when student work was completed during Habits of Mind lessons. Artifacts collected included: individual blueprint designs, group blueprint designs, student journals, and photographs of student work.

Professional Teacher's Journal

A professional teacher's journal was used to record notes after each integrated STEM or Habits of Mind lesson. Included in the professional teacher's journal are lesson structures, informal student observations, changes and adaptations for future lessons, professional reflection, and next steps. This was helpful in guiding future problem solving lessons.

Data Analysis

Student interviews, formal and informal student observations, student artifacts, and the professional teacher's journal were analyzed on a case-by-case basis, examining each data sources from each student. Formal observations of students' learning-related skills were used to identify initial rates of initiative to problem solve and to monitor changes in ratings of student initiative throughout the study. The teacher determined that a proficient rating of initiative was displayed by five or more consistent learning-related skills, a progressing rating of initiative was displayed by three or four consistent learning related skills, and a beginning rating of initiative was displayed by two or fewer consistent learning-related skills. See Table 5. Individual student interviews were transcribed by the researcher. Then, data were sorted according into student specific sets. The researcher then openly coded each data set in the following order: formal observations, professional teacher's journal/ informal observations, student interviews, and student artifacts. Open codes were then combined to identify commonalities and generate themes related to student initiative. Common themes among the three students were identified throughout the data sets. All data were used to identify changes in student initiative to problem solve during and after implementing integrated STEM and HoM lessons.

Table 5

Ratings of Student Initiative Based on Learning-related Skills

Rating	Number of Consistent Learning-Related Skills
Proficient	5 or more
Progressing	3 – 4
Beginning	2 or fewer

Summary

This research was important to the future implementation and success of integrated STEM in the early childhood classroom. By studying the results of one classroom over the course of nineteen weeks, the teacher was able to gain insight into the effect of integrated STEM lessons in the early childhood classroom to help students foster their independence and ability to take the initiative to problem solve. Using learning-related skills from the Cooper-Farran Behavioral Rating Scale (1991) to record student abilities, the teacher was able to determine baseline information about students and compare those results to observations throughout the study period. This helped the teacher identify rates of initiative during and after implementing integrated STEM and HoM lessons. Student interviews gave insight into student thoughts and feelings toward integrated STEM, which assisted the teacher in understanding what might have caused changes in the learning-related skills. Lastly, the professional teacher's journal provided an opportunity to collect informal observations of students and for the researcher to reflect on classroom lessons and prepare for future lessons. Observations, interviews, student artifacts, and the professional teacher's journal collectively support the findings of each individual data source.

CHAPTER 4: FINDINGS

Overview

Through the analysis of data collected for Tanya, Thayer, and Aaron some common themes arose. Formal observations showed each student's ability to use the learning-related skills (self-control, stay on task, organize materials, work independently, listen to and follow directions, and participate appropriately in a group) throughout the study. The professional teacher's journal and student artifacts collected, showed varying levels of students' personal interest, participation, leadership, and perseverance. The findings for each student are explained below.

Tanya

Throughout the nineteen-week study, Tanya exhibited a proficient rating of the learning-related skills on a consistent basis, as seen in Table 6. She only struggled to be consistent in listening to and following directions. It was observed that while she did listen to directions, she liked to do her own thing and often did not follow the specific directions given.

Tanya showed a personal interest in integrated STEM lessons from the beginning. In her first interview she responded that she likes STEM lessons more than other classroom activities "because, like you can add stuff to it and think about your own stuff that you want, and it's all different than everybody else's." Tanya was eager to think about and do things that involved her own thinking. This was an early example of her metacognition. Metacognition, a HoM, is the ability to think about your own thinking. And, at the end of an integrated STEM lesson she commented, "That's the end? That was such a short lesson!"

Table 6

Tanya's Formal Observation Data

Date Observed	Jan 23	Jan 28	Feb 2	Mar 5	Mar 20	Mar 28	Apr 12
Using Self Control	+	+	-	+	+	+	+
Staying on Task	+	+	+	+	+	+	+
Organizing Work Materials	+	+	-	+	+	+	+
Working Independently	+	+	+	+	+	+	+
Listening and Following Directions	+	-	-	+	-	+	+
Participating Appropriately in Groups	na	-	na	+	+	na	na

On several occasions, Tanya was recognized as being a leader in the classroom. She was seen sharing her ideas with her groups, giving her group members jobs, and participating in classroom discussions. When asked if she participates appropriately in her group she replied, "Yes, I'm just like you can do this or you can do that and I let people choose. If people forget, I try to give them directions and I try to give them what to do."

Tanya also made many references to perseverance and exhibited perseverance throughout the study. She worked with her group to try the first idea they developed, but if it wasn't successful she would suggest ways to redesign the idea. Her team was usually open to her ideas. Tanya knew she was persevering and understood this was an important part of integrated STEM and Habits of Mind lessons. Many times throughout the study, she would make a comment of her perseverance, "I try a lot of times. Sometimes it doesn't work, sometimes it does. I keep trying on the problem." Perseverance can be noticed in multiple blueprint drawings and informal teacher observations notes that describe the multiple design iterations from her different teams.

An example of her perseverance occurred during our Chicka Chicka Boom Boom integrated STEM lesson, taken from the book *STEAM Design Challenges*. Students were given the following dilemma: Using only two materials, can you build a letter or number that can stand on its own so the children from the *Chicka Chicka Boom Boom* storybook by Bill Martin Jr. and John Archambault, can use it to climb to the top of the trees? Tanya and her group decided to mold clay to make the tall sides of an uppercase H and add straws to the outside as a support. Students were given thirty minutes to create their design. During that thirty minutes Tanya's group was observed to have conversations regarding how unsuccessful their original design was and then proceed to redesign their letter H. Together Tanya and another teammate worked to put the straws inside the clay, rather than outside of the clay. Later, during whole group discussion, when asked what students learned from the STEM lesson, Tanya responded "Perseverance! We kept thinking of ways to make an H that would work and we didn't give up!"

In addition, Tanya's individual blueprint designs and journal representations are complete with recognizable details. Her drawings are neat and organized. Any words add information relevant to the content studied or a HoM learned.

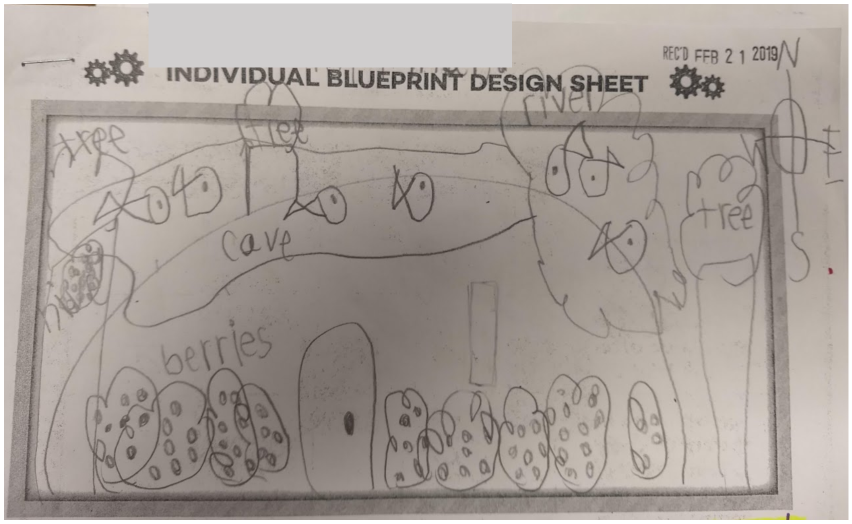

Figure 1. Tanya’s individual blueprint for the *Bear is Lost* challenge

Thayer

In the beginning of the study, Thayer did not exhibit the ability to use any of the learning-related skills during formal observations. He performed at a beginning rating. As the study carried on, he began to exhibit the skills with a steady increase. By the end of the study, Thayer was rated proficient in exhibiting all of the learning-related skills consistently, throughout the observation. These results can be seen in Table 7.

Thayer often struggled to stay in control of his actions and stay on task. One observation of this occurred during a 100th Day challenge. Students were paired with a classmate and challenged to design a standing numeral 100 out of the 100 materials given to them. Thayer’s team was given 100 pennies. Thayer’s teammate had an idea on how to start the ‘0’ but struggled to form it. This happened in part because Thayer tossed pennies across the room and used the work that his partner was accomplishing as a target.

Table 7

Thayer's Formal Observation Data

Date Observed	Jan 23	Jan 30	Feb 27	Mar 13	Mar 21	Apr 10
Using Self Control	-	-	-	+	+	+
Staying on Task	-	-	-	-	-	+
Organizing Work Materials	-	-	-	-	-	+
Working Independently	-	-	-	-	+	+
Listening and Following Directions	-	-	+	+	+	+
Participating Appropriately in Groups	na	-	+	+	+	+

During the initial interview, Thayer stated that he was not in control during STEM lessons "because, I get out of control. I run everywhere." During observations after this interview, Thayer began to modify his own behavior when the teacher was in close proximity. One example of this was during the group blueprint design step of the lesson Bear is Lost. Students were instructed to share their individual design, listen to each group member's design, and choose a map design for the group. Each group was to complete one group blueprint for the entire group with colorful picture representations that were labeled. Thayer's group was allowing one student to do most of the work on the group design. Thayer was not working or contributing to the group. Instead, he was playing with the pencils in the supply basket. When he noticed the teacher walking toward his group, he put the pencils down, grabbed a crayon, and began helping his group color the group blueprint.

Another example of Thayer modifying his behavior when in close proximity to the teacher was during the Farmer's Pen HoM lesson. Students were given playdough and q-tips to build their animals. Thayer's group members were working to solve the problem, while he was repeatedly squeezing playdough and making small talk. When the teacher arrived at his group, he shouted "We need to work fast!" and began building a cow out of playdough and q-tips. During the closing interview, when asked if he stays in control, he then responded "Yes, since I'm following what everyone says and we're making a plan. Like what you say we can do, how nice we can do it." Thayer was not showing independence in learning tasks, but was aware of what he should be doing and changed his behaviors when the teacher was nearby.

When asked in the initial interview, Thayer said he does like the STEM lessons, but he "would rather do other lessons like reading, because I need to learn how to read." In the beginning of the study, Thayer's personal interest was to learn to read. He was less excited to work on integrated STEM lessons because they did not coincide with his personal interest. Another one of his personal interests was building. This was noticed by his repeated gravitation to the blocks center during free choice time. In the closing interview his response reflected a change in attitude and deeper personal interest to STEM. He again reported liking the STEM lessons but, this time commented "since they are really fun and you can build."

The teacher's professional journal reflects that Thayer often participated in whole group discussions. However, he did not exhibit the same leadership skills that Tanya had. Instead he often needed reminders to keep working.

During the integrated STEM lesson, Swine Shleter, he began to show signs of perseverance. He made a choice to redesign the group's idea during the create stage of the lesson. And, after finding that this design did not work, he asked to use his free choice time to continue working on a solution.

Thayer gave little attention to detail in his blueprint designs and journal reflections. His drawings are simple and it is difficult to decipher what was drawn. If written words are present, they may or may not help with understanding. When asked to label his drawings, he only wrote the words in a list on the side of the page.

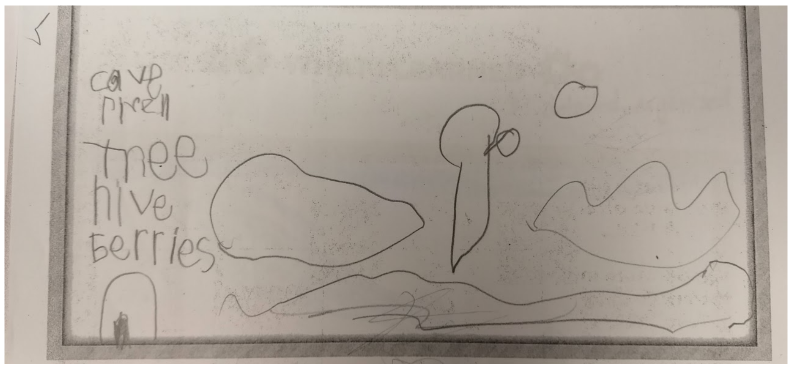

Figure 2. Thayer's individual blueprint for the *Bear is Lost* challenge

Aaron

After the first two formal observations of Aaron's learning-related skills, he was exhibiting an inconsistent ability to use the skills. He had been rated proficient in his ability to use most of the skills during the first observation and was then rated beginning when he showed none of the skills in the second observation. It was decided to average his first two ratings for a progressing rating. Throughout the next nineteen weeks, he began to show the ability to use all of the learning-related skills consistently and was rated proficient at the end of the study. This progression can be seen in Table 8.

Table 8

Aaron's Formal Observation Data

Date Observed	Jan 8	Jan 23	Jan 30	Feb 2	Mar 5	Mar 20	Mar 28	Apr 12
Using self control	+	-	+	+	+	+	+	+
Staying on task	-	-	-	-	+	+	-	+
Organizing work materials	+	na	+	+	+	+	+	+
Working independently	+	-	-	-	+	+	+	+
Listening and following directions	+	-	+	+	+	+	+	+
Participating appropriately in groups	+	na	+	na	+	+	na	na

Aaron was the least decisive of the three about integrated STEM lessons. During the initial interview, Aaron said he liked STEM lessons less than other classroom activities "because STEM activities, some are funner and some aren't." When asked to tell more about what he meant, he easily responded that he had liked the boat lesson and the wild animal lesson, however he had trouble pinpointing what was not fun. He was sure he didn't like them as well as other activities, but couldn't recall what he didn't like about them. At the closing interview, his response had changed. He then replied, yes he likes STEM lessons "because they are fun and because you get to build things and try different things." When the lessons appealed to his interests, such as building, he liked doing them. Having the ability to try different things, was also important to him.

Aaron, like Thayer, participated during many classroom discussions, but did not exhibit the other leadership skills that Tanya had exhibited. It is noted in the professional teacher journal, that he often did other things rather than the intended activity or would sit and do nothing while his teammates completed the activity. During the integrated STEM lesson: Chicka Chicka Boom Boom, Aaron worked around his partner who was not participating in the challenge. He talked to his partner about many things, but never encouraged his partner to help with the challenge.

Aaron exhibited perseverance during the integrated STEM lessons by making attempts to redesign his work. During the 100th Day challenge his team was given 100 pipe cleaners. They were struggling to make the pipe cleaners stand up on their own. Aaron did not give up, though. He continued to try different designs until, he found that twisting the pipe cleaners together made them stronger. Due to time constraints, his team did not finish the challenge. They did find a design that, given more time, could have worked. Another example of this was during the Swine Shelter lesson. After learning about flood waters, teams were challenged to design a home for the Three Little Pigs that would be safe from flood waters. While Aaron's team attempted three different designs, they struggled to work together and reach a team solution to the challenge. So, Aaron asked if he could use his free choice time at the end of the day to continue redesigning for an end product that would not flood therefore, keeping the pigs and their home safe. When he was successful, he approached the teacher with a request to raise the flood waters so he could continue to improve his final design.

In review of Aaron's blueprint designs and journal reflections, his drawings show little detail but are organized and recognizable. He provides just enough detail to get his point across. Written words add to the understanding of the drawings and show understanding of content knowledge learned.

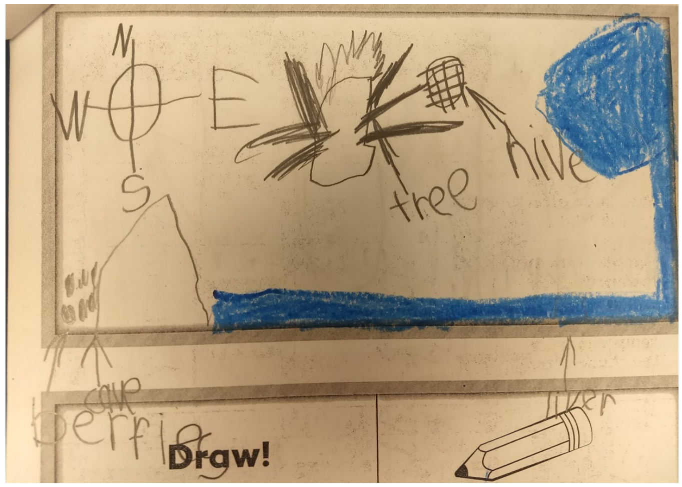

Figure 3. Aaron's individual blueprint for the *Bear is Lost* challenge

Common Themes across Students

The three case study students exhibited different abilities in learning-related skills related to initiative at their initial observations. See Figure 4.

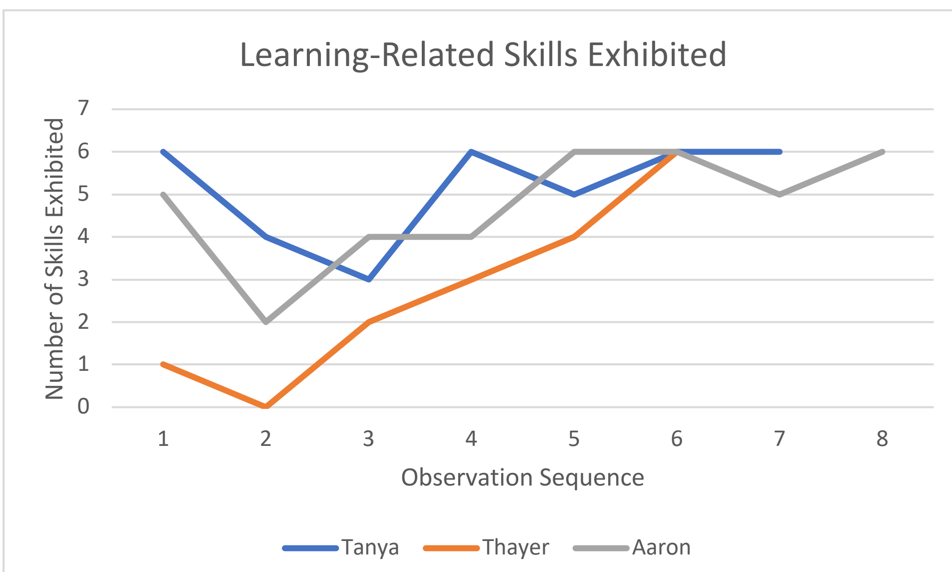

Figure 4. Learning-related skills exhibited by each student in order of observations

While Tanya's and Aaron's abilities fall into the same proficient range to start, Aaron's abilities took a steep dive into the beginning rating at the second observation. It is observable however, that each of the students improved in their ability to consistently exhibit learning-related skills over time. When the skill was not applicable to the lesson, it was counted as exhibited so that the student's rating would not be affected negatively by skills not applicable to a lesson.

When openly coding data sets for each of the three students, common themes arose. Each of the three students indicated a level of personal interest in integrated STEM lessons and exhibited stages of whole group and small group participation, perseverance, and detail given to written work. Personal interest was especially evident in student interviews, but also through observations of engagement in lessons and student artifacts. Whole group participation was most noted during informal observations in the professional teacher's journal, while small group participation was also recorded during formal observations using the Observation Matrix. Perseverance was noted when redesign was evident in student artifacts and informal notes by the teacher in the professional teacher's journal. Detail given to written work was assessed through the analysis of student artifacts. Each student was on their own unique journey, beginning at different stages of skill development and continuing through subsequent stages.

Summary

At the beginning of the study, Tanya, Thayer, and Aaron exhibited varied abilities of consistent learning-related skills. By the end of the study, the students showed similar abilities in consistent learning-related skills. All of them ended with a proficient observation rating. Student interviews and informal observations recorded levels of personal interest. Tanya was always eager to dig in and get busy with a challenge. Thayer and Aaron began the study less enthusiastic about integrated STEM lessons, but later commented that the lessons were fun and gave personal reasons for enjoying them. While each of the students in the case study participated often during whole group discussions, Tanya showed other leadership skills. She encouraged other students to engage in the lessons and work on the design projects by providing reminders and direction to her teammates. The professional teacher's journal and student artifacts gave insight to student behaviors, engagement, and interest.

CHAPTER 5: DISCUSSION AND CONCLUSIONS

Overview

Each student, Tanya, Thayer, and Aaron, showed individual skills and abilities related to personal interest, participation, leadership, and perseverance. Each of these can be related to their initiative to problem solve. The three students analyzed in the case study began with varied rates of initiative, as indicated by their individual learning-related skills. Over the period of the study, the students' initiative changed at their own pace.

Discussion

Personal Interest

As noted by researchers, Moomaw (2016), Katz (2010), and Berry et al.. (2012) personal interest and curiosity are important to students' motivation, and in turn, their initiative to learn and problem solve. While Tanya began with a personal interest in integrated STEM activities, Thayer and Aaron were more skeptical. Tanya's feelings and personal interests were not changed throughout the study. At the end of the nineteen weeks, Thayer's thoughts about integrated STEM lessons had shifted. Thayer was able to make a connection to building things during integrated STEM lessons and later reported that these lessons were fun. Aaron also held a personal interest for building and reported enjoyment in the lessons. He liked the open ended process of integrated STEM lessons. The students all ended with a positive attitude in regards to integrated STEM activities. Thayer and Aaron seemed to report enjoying lessons in integrated STEM when they held a personal interest in the lesson. When students have an invested interest in what they are about to do, they are more likely to have the initiative to begin. In research conducted by

Tippet and Milford "ECE's (Early Childhood Educator's) viewed STEM as a useful approach to teaching that allowed them to capitalize on student's interests and to think about their teaching in a more purposeful way." (2017, p. S82)

Participation

Each of the students in the case study held high levels of participation in whole group discussions. Participation has the potential to motivate students to take the initiative to problem solve. Research completed by Campbell (2006), suggests students need to think and communicate with clarity and precision, think interdependently, and pose questions and problems to be successful. Through classroom participation, students are provided the opportunity to practice HoM in a safe, guided environment so students become confident in their metacognition and begin to draw on these abilities independently. When students begin to use those skills independently, they will be taking initiative to solve problems, a highly sought-after vocational skill in the 21st Century.

Tanya was able to carry this participation into individual and team efforts. She consistently held self-control, stayed on task, organized work materials, worked independently, and participated appropriately in her groups. Her personal interest was also high to start and so it was expected that she would continue to show a high level of engagement. She was, as Goldenberg (1996) explained, "likely" to use HoM.

For Thayer and Aaron, small group and independent participation were more difficult to achieve. Especially at the beginning of the study, Thayer struggled to stay on task, work independently, and use self-control at a level appropriate for a Kindergarten age student. As mentioned above, he was not personally interested at this time either. Slowly, he began to achieve success with learning-related skills and, once achieved, exhibited them consistently. This may have been in part due to teacher proximity. His engagement in lessons changed on more than one occasion due to the proximity of the teacher. For him to be aware of his choices and how to change them is important to note. Carroll, et al..(2016) suggests that students need to be aware of where they are in the learning process. Thayer's ability to change his actions due to the teacher's proximity shows he is aware of his learning process and this ability gives hope that he can make choices more conducive to learning in the future. However, over the course of the study, his personal interest also changed. As he became aware of his learning and his personal interest in the lessons increased, this research suggests that his initiative to problem solve also increased.

Aaron's struggles were in his ability to stay on task and work independently. Due to his low level of personal interest, this was not surprising. As his personal interest in integrated STEM changed, he became more invested in the lessons and he began to show consistent signs of learning-related skills.

Leadership

Participation in classroom activities is one form of leadership that each of the case study students exhibited. However, Tanya was observed to do more than just that. She often engaged her teammates in meaningful conversations about the lesson they were working on and delegated jobs to her teammates. By doing this, she took on a leadership role in her team. This suggests that she understood the content and was confident in her abilities enough to guide her team. Participating appropriately in groups is one of the learning-related behaviors identified by Cooper and Farran (1991) to lead to success. This leadership also shows that Tanya takes initiative to solve problems. She easily utilizes design thinking as described by Carroll, et al.. (2010) and is not afraid to take risks.

Thayer and Aaron were not observed to have had the same initiative to be leaders in their groups. However, they did not possess the same learning-related skills as Tanya in the beginning. Thayer was just beginning to exhibit all of the learning-related skills and Aaron had been showing them consistently for four weeks. Maybe, with time and more exposure to integrated STEM lessons, they would have also begun to show the same leadership skills. A longer study would be required to gain insight as to if integrated STEM lessons would have this impact.

Perseverance

Katz (2010) encouraged the use of Project Approach learning so that students can work to answer their own questions. She stated “children are innately curious and eager to explore their environments and learn about a wide variety of causes and effects” (Katz, 2010, para. 28). This study noted varied introduction points of student perseverance, related to their eagerness to explore. Tanya having begun with personal interest and all learning-related skills, showed perseverance throughout the study. She often shared with the class that she had not given up and had continued to work to find a solution. Thayer exhibited perseverance at the very end of the study, which correlates with his personal interest and learning-related skill development. Aaron’s perseverance came out at random throughout the study, similar to his initial learning-related skills. When his learning-related skills were at a consistent rate toward the end of the study, his perseverance was highest. It was at this time that his interest also peaked because the lesson was centered on construction. This is the same motivation that author Moomaw (2016) suggested that infants and toddlers have when they engage in play-based learning that interests them.

Initiative

Tanya certainly appears to possess the learning-related skills for success noted by McClelland et al.. (2006) and HoM necessary to be defined as a "peak performer" by Coast and Kallick (2000). By exhibiting her ability to draw on these skills, she takes initiative to problem solve in various situations, including integrated STEM and HoM lessons. She is highly involved in each of the themes that emerged: personal interest, participation, leadership, and perseverance.

Thayer showed the least initiative at the beginning of the study but over time he exhibited consistency in learning-related skills. His results could conclude that interventions to learning-related skills, as suggested by McClelland, et al. (2006), do help students become more fluent in those skills. Integrated STEM and HoM lessons could be one intervention to learning-related skills. Thayer's learning-related skills, initiative to problem solve, and perseverance seem to have been positively impacted through the implementation of integrated STEM and HoM lessons in his Kindergarten classroom.

Aaron's rating of initiative was inconsistent and fluctuated throughout the beginning of the study. Half way through the study, formal observations began to show consistent use of all learning-related skills. This was after parent-teacher conferences, which could have made an impact on his behaviors, but more likely this is when his personal interest began to motivate his behaviors. While all of the integrated STEM lessons were real-world based, the Swine Shelter lesson was directly related to the flooding Nebraska endured during the month of March. This authentic context could have made a direct impact on Aaron's personal interest, motivation, and initiative as suggested by researchers Berry, et al.. (2012) & Katz (2010). The research suggests that Aaron's learning-related skills, initiative to problem solve, and perseverance were positively affected by personal interests being introduced through integrated STEM and HoM lessons.

Conclusions

Students who find intrinsic value in problem solving are more likely to take the initiative to solve the problem. "Research shows that integrative approaches improve students' interest and learning in STEM."(Becker & Park, 2011, p.23) This case study research is consistent with previous research by Berry et al.. (2012), Katz, (2010), & Moomaw (2016) that suggests a student's personal interest is a high motivator to taking the initiative and persevering through a task. This study also provides supporting evidence for the "interest and engagement" goal and "educational persistence" outcome developed by Honey, Pearson, and Schweingruber (2014) for integrated STEM lessons. Students involved in this study enjoyed integrated STEM lessons because, the lessons were fun and students liked trying their own ideas. Therefore, this study suggests, teachers should invest time into learning about their students' interests in an effort to design lessons that motivate student learning. Integrated STEM and HoM lessons, were effective in peaking student interest during this study and may be useful to implement in the early childhood classroom to improve student initiative.

The research suggests that, while Kindergarten students may exhibit high levels of participation in whole group discussion, it is more difficult for them to maintain this high level of participation in small group collaborative efforts and individual work. Less motivated students, whom may have less personal interest in a topic, may need reminders to continue working or to be in close proximity of the teacher for participation to occur. This study suggests that teachers should incorporate a variety of relevant, authentic contexts that appeal to their students so that they can leverage personal interest in a variety of classroom settings.

The case study also suggests that students who have achieved learning-related skills may also increase a student's confidence to a point that they display leadership skills. When working in collaborative groups, having a leader can be an important tool for success. It is certainly a skill that future employers will be looking for. This research suggests teachers can help students develop their learning-related skills through integrated STEM and HoM lessons which provide intervention opportunities to practice these skills.

This research study will help to guide future lessons in the classroom, as well as students toward successful problem solving. Insights from this study can inform teachers as they work to design lessons that develop the whole student for future success. This study suggests that teacher's will better motivate students by appealing to each student's individual interests. This can be done by introducing a variety of real-world applications into the classroom, possibly through integrated STEM and HoM lessons that also give students the opportunity to practice learning-related skills.

This study will impact my own teaching practice in a number of ways. I will take time to learn the personal interests of my students and use their personal interests to develop authentic, relevant lessons that will better engage my students during lessons. Integrated STEM lessons were a useful design for preparing lessons that are authentic and relevant, so I will continue the use of integrated STEM lessons in the Kindergarten classroom. I will continue to assess students' learning-related skills, so that I can plan lessons that might encourage the development of skills that are lacking. Since learning-related skills are closely aligned to HoM, I will continue to implement HoM lessons in the classroom as an added intervention to developing learning-related skills.

Limitations

While, this study seems to have many positive implications for the implementation of integrated STEM and HoM lessons in the Kindergarten classroom, it does not come without limitations. This was a small class, which could have skewed the results. With a smaller class size, the teacher is able to reach more students for one-on-one instruction and intervention. Therefore, results may be different from those in a larger class size. Time was another limitation. Integrated STEM lessons take time to implement in the classroom. It was difficult to complete one lesson each week, especially with younger students. The students found it difficult to maintain interest in integrated STEM lessons for longer than 30 - 45 minutes. Lessons were only scheduled once a week so, projects were extended over several weeks. If lessons had been scheduled more than once a week, there would have been more opportunities for students to attempt problem solving, practice learning-related skills, and exhibit initiative. Also, case study students were not chosen for specific analysis until after the study was complete. If those students had been chosen right away, more observations of their specific behaviors could have been collected for analysis. Another limitation of the study is, disentangling what occurred as a result of the integrated STEM and HoM lessons, versus general learning, maturations, and development that occurs during children's Kindergarten year. One could compare these results to a classroom that was not implementing integrated STEM and HoM lessons to gain further insight into this limitation.

Future Research

Having completed this study, it would be interesting to study these students longitudinally, assessing their continued use of learning-related skills, initiative to problem solve, and academic achievement. A longitudinal study could give insight to the importance of implementing integrated STEM and HoM lessons during early childhood education to increase problem solving skills.

Another important study to conduct, should focus on academic achievement. A comparison study between two Kindergarten classrooms, one implementing integrated STEM and HoM lessons and the second without the implementations of these lesson designs would be useful. A study of this nature might give further insight into the effect of integrated STEM and HoM lessons on academic achievement.

This study focused on the development of initiative through learning-related skills. In a future study, researchers should focus on developing a set of essential Habits of Mind specific to the developmental needs of Kindergarten students for future success. If the HoM are not connected to a specific content area, and rather to the development of the whole child, then the HoM could increase future success. Researchers would then need to study Kindergarten students' development of the essential HoM. Research of this kind could help teachers provide purposeful interventions, such as integrated STEM lessons to help a student develop essential HoM.

In this study, Tanya appeared to possess leadership skills from the beginning. It would be interesting to conduct further research to see if, through integrated STEM lessons, Thayer and Aaron begin to exhibit student leadership in collaborative groups. They were both exhibiting consistent learning-related skills at the conclusion of the study. Through continued use of those learning-related skills, they might eventually begin to show leadership skills like Tanya.

Finally, research has shown that integrated STEM education is a best practice for the Kindergarten classroom. However, there is little research available to give teachers direction for implementation. Future research should investigate how to best introduce integrated STEM into the Kindergarten classroom.

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APPENDIX A: Student Interview Questions

1. When you work on a STEM activity, do you
   a. Stay in control (yes/no) How do you know?

   b. Stay on task (yes/no) How do you know?

   c. Listen and follow directions (yes/no) How do you know?

   d. Participate appropriately in your group (yes/no) How do you know?

2. Do you like the STEM activities more or less than other activities we do? Why?

3. Is there anything else I should know about you to better understand your behaviors during STEM or your STEM experiences in general?

APPENDIX B: Student Observation Matrix

Name ________________ Date ______

Lesson __________________

Using self-control	
staying on task	
organizing work materials	
working independently	
listening and following directions,	
participating appropriately in groups	
Additional observations:	