Educators' Descriptions of Urban STEM Students' Academic Achievement and Mental Health: Pre- and Current Pandemic

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Abstract

The Coronavirus pandemic has significantly impacted various aspects of life, including education. This mixed-method study examines the effects of the pandemic on general interest in STEM lessons, the development and application of STEM soft skills, and observations of signs of trauma in urban classrooms. The foundation of this study is the theoretical framework of social learning, behavior modification, and progressive education. There is limited literature regarding the effect of the pandemic's altered educational methods on STEM disciplines within urban schools. Using a mixed method study methodology, 42 Midwestern United States educators participated in a survey regarding student STEM interest and STEM soft-skill development and observed classroom trauma signs. Ten of these educators participated in a follow-up interview to identify similarities. The findings indicate increased students' STEM soft skills development and a more equal distribution between males and females in STEM interest and classroom applications of STEM soft skills. Educators also reported a decrease in students' work ethics, difficulties with critical thinking, and conflicting interests in classroom technology usage. Educators also reported a higher rate of signs of trauma in classrooms for both males and females. The findings' significant implications include the relationship between STEM interest and soft skills, the effect of the increase in technology usage, and the impact of social media on students.

Keywords: COVID-19, STEM education, Urban education, trauma, soft skills

Dedication

This is for all the kids in urban schools, judged by their birthplace. You are more than your zip code. I was told once to return to Youngstown when I stumbled academically. Little did I know I would go back. However, this time, I want to earn a degree and ensure that no one ever talks to any student. You are more than your hometown. You are more than your trauma. You are so much more than you even realize. You matter. You are important. Things can and will get better. Everything takes time.

I would not be where I am if not for my grandma, who always encouraged me. She came to every concert, every graduation, every ceremony- every single event. Every Tuesday and Thursday afternoon, I would call her on my way home from work, and we would talk for hours. It has been three years since we lost her, and I miss those calls greatly. She is still my motivation. She was always there to support me, and would even send my scholars love, support, and sometimes candy. There has not been a single day I have not missed her.

So, for my grandma, who understood why this is so important, and for the students who need someone in their corner- this is for you. I love you all. You got this.

Acknowledgments

My mom is my rock. Her "make it happen" attitude has made years of magic, love, and inspiration an everyday occurrence my entire life. My sister, brother, and I were never aware of any hardships, and we never knew we went without. My dad instilled a sense of pride and drive in us, which has gotten me to this point today. Thank you to my incredible parents and their never-ending love and support.

Moreover, Mom- you were right. I should have just gone into education, like you said. Here it is in writing. Dad, I appreciate how many fish you missed when helping me with homework and watching my kids for the past 20+ years.

My husband is the most intelligent, caring, and supportive person. His constant words of encouragement have kept me motivated. Simultaneously, his open arms comforted me when I felt it was impossible to complete my studies. His dedicated time is insurmountable. He knew this degree was my goal when we were kids, and he never stopped supporting it. Thank you, Brett, for the hugs, support, and late-night runs for salt and vinegar chips. You. my dear, are my favorite.

My children, Teddy and Lucy, who have grown from toddlers to school-aged children during this study, have been my cheerleaders who have yet to completely understand what they are cheering for. I am so excited to have achieved this goal with your help, and I am ready to dedicate so much more to you now. Lucy, little sassy princess- I see many more Taylor Swift dance parties in our future. Teddy, my rambunctious dude: I might actually have the energy to keep up with you now. Maybe.

Finally, we would like to thank the scholars. Four years ago, I made a significant career change at school, which inspired my studies. My freshman that first year after the

pandemic made me the teacher I am today. I can never thank them enough for pushing me beyond my comfort zone. I am who I am because of these scholars. Now that they are seniors, I graduate alongside them. I am so proud of them and eternally thankful for how stubborn and challenging they were then. I would not be who I am without them now.

My family and scholars–You are my inspiration. Thank you for being there for me.

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Chapter I

Introduction

The coronavirus of 2019 changed the world as humankind knew it. This deadly novel virus has affected the world (CDC, 2022). Humans were forced to put more thought into everyday life, including each item bought, the dollar spent, politics, and even touching any surface (McKinsey & Company, 2022). In 2019, schools closed in the United States of America, stores operated in limited capacities, and masks and social distancing were mandated. After two years, with the onset of vaccines, panic decreased, and people began to return to everyday life (CDC, 2022).

Although life has returned to normal for most, one extensive group is still dealing with the fallout of shutdowns. This group comprises 55 million students currently enrolled in public or private schools in the United States. Most of these students were sent home, and some did not return until the 2021-2022 school year (*National Center for Education Statistics* 2022). These students lost valuable years in the classroom, which undoubtedly had an effect (Quinn & Polikoff, 2022). Recent studies have begun to explore the impact of the pandemic on students, most shocking of all, and the toll on student mental health (Bruni et al., 2022). During the pandemic, more children were exposed to traumatic experiences during the lockdown, ranging from mental, verbal, and physical abuse to violence (Ulukol, 2022).

Educators have experienced the pain of the pandemic in classrooms (Turner, 2022). In some cases, students performed worse on standardized tests in the 2021-2022 school year than those who took standardized tests in Louisiana after being hit by Hurricane Katrina in 2005 (Kuhfeld et al., 2022). The students hit hardest by the

pandemic were already defined as at-risk, and typical students in suburban and rural areas had less difficulty in virtual learning (Turner, 2022). Although some students struggled with the remote educational platform, urban students struggled the most, showing minor growth during remote learning (Najarro, 2022).

A recent study from The Netherlands showed that students experienced little skill loss during the pandemic, which is believed to be a result of short school closure times, proper educational funding, and pre-established access to technology (Engzell et al., 2021). However, low-income and disadvantaged students in the Netherlands still have considerable social, economic, and academic gaps (Engzell et al., 2021). In Northern Cyprus, 75% of students were likely to experience depression and depression-like symptoms (Manyeruke & Ergün, 2022). In Australia, the general public's mental health is worse for people living in larger cities and urban areas (Wang et al., 2022). Malaysian urban students with asthma performed better with online learning as it provided a safe learning space (Raima et al., 2022). Students in the Philippines have found that creating standards and guidelines for online education would benefit both students and teachers (Beruin, 2022). Recently, Peruvian University female and/or undergraduate students reported the highest levels of stress during the pandemic. Although these groups were identified for this reason, the study also found a general feeling of social anxiety in all grades (Mejia et al., 2022). The effects of this pandemic have been observed worldwide.

However, before the pandemic- schools began incorporating more life-skills-focused science, technology, engineering, and math (STEM) lessons to better prepare students for careers (TeachEnginnering, 2022). The five key characteristics of the STEM

curriculum are real-world applications, hands-on learning, engineering design processes, teamwork, and inquiry-based learning.

Before the pandemic, many urban secondary students began receiving new, practical, and gap-closing STEM instruction. Still, the pandemic shutdown halted all opportunities, forcing them to miss developing real-world skills through STEM-focused courses (*Education in a Pandemic,* 2021). STEM-related courses are typically structured with problem-based or project-based learning opportunities on topics rooted in real life (Jolly, n.d.). Without face-to-face classes, where students work in teams and have hands-on experiences, they suffer academically (Special Education and Rehabilitation Services, 2021).

Although the devastation of the pandemic was widespread, it may have had the most significant long-term impact on school-aged students. The number of students who experienced trauma in the pre-pandemic world was already high, making it even more critical for education professionals to learn the severity of the effects of the pandemic on urban students who were likely to have previously experienced trauma. Trauma may have come from students' firsthand experiences related to someone else within their lives or from the sudden and mandated recluse of students (Nadeem & Van Meter, 2023). These students were more likely to resist online learning, leaving many performing poorly in classes and standardized tests (United Nations, 2020). While education was only social interaction for some students, any negative association with virtual learning may have deepened their emotions regarding the pandemic shutdowns and loss of social engagement.

Statement of the Problem

It is unknown how midwestern urban school districts' educators rate and describe student interest in STEM lessons, students' soft skills development, and signs of trauma in the classroom from the beginning of the pandemic to the present. The pandemic was unfamiliar and terrifying for the students, as school closings forced them to adapt to solitary lifestyles (Levinson & Markovits, 2022). As students returned to classrooms, it was difficult for teachers to immediately revert to previous expectations, including their application of soft skills. One study found that students were uncomfortable and unable to perform basic soft skills defined in the study as communication, teamwork, and the teaching of others (Gnecco et al., 2024). A German study found that the longer students were out of school, the greater the reverse effect on their mental health. This study also found that those with declining mental health were typically boys, younger teenagers, and families with a “smaller living space” (Felfe et al., 2023). Brooks et al. (2020) found that the COVID-19 pandemic had long-lasting adverse effects on school-aged students. Returning to the classroom in 2022-2023 brought novel issues, such as struggles to adapt to face-to-face instruction, a lack of student engagement, and a race to recover lost classroom time for educators to adapt to unprecedented student needs (Department of Education, 2021). The literature has shown the effects of the long-term use of virtual lessons on students’ STEM interests and STEM-related soft skills, mental health, and pandemic-induced or exacerbated trauma-related classroom behaviors. However, there is a gap in the literature on how urban students respond to STEM lessons, apply STEM soft skills, and accompany observed signs of trauma during classroom lessons.

Purpose Statement

The pandemic brought education from school buildings into the home, leaving parents feeling the novel stress of academics and the uncertainty of the pandemic. There is a general fear of academic and behavioral deterioration in students as their virtual learning continues (D'Souza, 2022). STEM students identified the pandemic's virtual educational style as problematic due to the questionable quality of the education, the disconnect from others, and the difficulty in adapting to a new mandated lifestyle (Selco & Habbak, 2021). One study by Soysal et al. found that in one semester in 2020, the student confidence level dropped by approximately 14% (2022). The same study also found an increase in dropouts of 29% (Soysal et al., 2022).

The pandemic has led to students questioning their education and themselves. This mixed-method, descriptive study aimed to understand how Midwestern urban school educators rated and described student interest in STEM lessons, students' soft skills development, and observed signs of trauma from the pandemic's beginning to the present. In Part A of the study, educators rated their students' STEM interest, soft skills, and signs of trauma through a survey of Likert Scale items, multiple choice and open-ended questions, and pre-pandemic through the present. In Part B, educators explained their perspectives on students' soft skill development through interviews with the researcher. Understanding teachers' ratings and descriptions of general student interest in STEM lessons, students' soft skills development, and observed signs of trauma throughout the pandemic allowed the researcher to compare and identify where students needed the most support.

The results of this study will benefit future employers and workers, and the study may benefit students' future employment opportunities and contributions to the world.

Understanding educators' ratings and descriptions of general student interest in STEM lessons, students' soft skills development, and observed signs of trauma through the pandemic will allow insights into what actions can be taken to develop educators to meet better the needs of students who have experienced trauma, especially those related to the pandemic.

To describe STEM educators' perceptions of general student interest in STEM lessons, students' soft skills development, and observed signs of trauma, the researcher administered a 22-question survey to the 42 educators. The survey was a Part A study and collected data regarding rated students' general interest in STEM lessons, students 'soft skills development through the pandemic, and observed signs of trauma in the classroom upon returning to the school. In Part B of the study, the researcher interviewed ten educators to gather their descriptions of general student interest in STEM lessons and students' soft skills development and observed signs of trauma during the pandemic.

Theoretical Framework

Social learning, behavior modification, and progressive education are theories that guide the importance of STEM as a discipline in schools to see student success in the future. Theories focused on trauma-informed education exemplify how learning can happen for students who have experienced these traumas. Progressive education outlines the importance of interdisciplinary education, which can be taught through STEM education. The convergence of these theories could hold the best possible outcome for modern-day students to cope with their trauma through education and prepare for their post-graduation (Berardi & Morton, 2019).

Social Learning Theory (SLT)

A. Bandura studied behavioral changes and their effect on students reacclimated to formal education from 1963 to 1997. These studies focused on how students acted in classrooms after experiencing a traumatic event that affected their ability to function in everyday life. Bandura theorized social learning theory, which concludes that students gather and learn social behavior from their classmates. Bandura theorizes the "Social Learning Theory" (SLT) from these studies. The SLT consists of five main points: learning is a cognitive process in social settings; learning can happen through observation of behavior and its associated consequences; learning involves analysis and conclusions of personal observation of others; and learners are active as they consider cognition, environment, and behavior (Bandura, 1977).

In this case, peers include other students in the classroom. Since students were removed from school and isolated from peers during the COVID lockdowns, these students had limited access to social learning. As Bandura theorized, students learn through social interactions and have limited social ability if trauma occurs in their lifetime. The National Survey of Children's Health (2010) conducted a study that found that, pre-pandemic, over half of the children, or roughly 35 million living in the United States of America, experienced at least one traumatic event before age 18, and that these children with trauma went on to experience even more traumatic events, leading to mental and/or physical health issues as adults. Suppose more than 65% of urban children experience trauma paired with the sudden loss of social observation due to the pandemic, which would typically lead to learning. In that case, the effects of the pandemic are more profound than just academic losses (SAMHSA, 2023).

Behavioral Modification as part of SLT

Bandura (1969) also discussed the principles by which behavior can be modified through personality, self-motivation, and environmental factors. Bandura discussed four significant behavioral changes: attention, retention, motor reproduction, and motivation. Understanding the attention of someone else long enough to observe them allows one to collect information from the observations. Retention is committing observations to memory, even in the future. Motor reproduction is the physical act of copying observed and retained actions. Motivation refers to the reason an action is committed, and it is because of some form of positive reinforcement (Bandura, 1969).

These different steps align with how students watch other students and how their educators act to form their understanding of educational processes. Without this social interaction, students are unlikely to have opportunities to make social observations, leading them to lack knowledge of base motor actions. Without constant observation and growth, students will likely be unaware of how to act or learn when returning to face-to-face lessons.

Progressive Education

J. Dewey (1938) focused on growing education beyond the classroom. Dewey discusses the importance of education as a progressive action. Education should not be a process with a defined cut-off date but rather a lesson for students to become lifelong learners. Dewey believed that the level of communication and interaction between students could lead to a deeper understanding of materials due to the sharing of perspectives (Dewey, 1938). Developing ideas and thoughts and engaging in education can cause students to explore their own abilities and ignite an understanding that would not be achieved through lectures or textbook-led learning.

These hands-on lessons are critical for a student's understanding, but they are also outlined as one of the five essential characteristics of STEM lessons, as defined by Jolly (2014). These five characteristics are real-world applications, hands-on use of the engineering design process, teamwork, and engaging with inquiry-based learning. These elements encourage lessons that encapsulate the engaging, memorable educational process that Dewey theorizes. These lessons are also continually adaptable as education changes and can be further addressed in the future through STEM education as a significant part of each STEM classroom lesson.

Application of Theory

Bandura's (1969) social learning theory acknowledges the issues that may arise when social interactions, such as school interactions, are removed from developing students' daily lives. Being aware of trauma in students as a probable factor in the lack of social interaction among urban students furthers the possibility of a decreased social learning outcome. These theories inspire this study, as they focus on students who are more likely to have experienced one or more traumas in their lifetime, along with a loss of social learning during a time dominated by increased STEM learning, which is typically social. This study aimed to collect the ratings and observations of Midwestern urban educators' students regarding their general interest in STEM, possible changes in STEM soft skills, and any signs of trauma between the school years of 2018-2019 (pre-pandemic)–2022-2023 (post-pandemic). These findings can be compared to the theories of Bandura and Dewey, which could benefit students, educators, parents, and school districts. The findings can help outline how students should be reintroduced into classroom settings.

Rationale for the Study

This study aimed to understand how Midwestern urban educators rate and describe general student interest in STEM lessons, students' soft skills development, and observed signs of trauma from the pandemic's beginning to the present. Current educators who experienced constant pandemic-related changes will provide a rating of 1-5 for STEM students' STEM interests, soft skills development, and trauma. Educators also described students' general STEM interests, their application of soft skills, and trauma in the classroom. In combination with educators' ratings, the researcher analyzed STEM educators' descriptions, thus constituting a mixed-methods descriptive design. Interview questions were developed based on Bandura's (1969) and Dewey's (1938) theories.

Methodology

Pandemic-induced shutdowns and mandated quarantines may have affected the development of the STEM skills of urban students. To better understand this phenomenon, a collection of Midwestern, urban educators' observations of student STEM soft skill development in the classroom must be completed to examine educators' views on students' abilities, specifically in these STEM skills, from the pre-pandemic school years to now. Participants rated and described teachers' perceptions of the differences in STEM students 'soft skills development from pre-pandemic to the present. These data could be used to develop action plans to adapt students to post-pandemic classrooms better.

The study included 42 educators teaching since 2018 in the Midwestern region of the United States. The study samples were chosen with purposive sampling, looking for educators at any level who used STEM practices within their classrooms. These educators

ranged from math teachers to the directors of STEM programs and aided in leading teachers. Participants were asked to complete a survey with Likert-scale items, multiple-choice, and open-ended questions.

The data were collected through Qualtrics, a web-based survey instrument in Part A, and one-to-one interviews with the researcher in Part B of the study. All personally identifiable information has been redacted. Educators with significant responses were asked to participate in further surveys. The additional questions in Part B helped establish the depth of the effects and identify the possible trauma and learning loss shown by students in the current pandemic classrooms. The nature of the study was made clear to participants as it relates to education during the pandemic, along with how the results will ultimately be used to draw related conclusions about any relationship between possible pandemic-influenced changes in STEM interest, STEM soft skills or observed signs of trauma. Participants were assigned an "Urban Educator" with a randomly assigned number. After the study's conclusion, these participants were informed of how data was and will continue to be kept on the researchers' computers in a file with a two-factor verification password system with complete deletion from all systems. Before any participant can sign consent, it will also be made clear that at any point in the study, any participant may withdraw responses without question.

Research Questions

This research will identify the status of pre-pandemic students' STEM-related skills and the same skills at the current point of the pandemic when most students are back in the classroom. The proposed mixed-methods study aims to understand Midwestern urban school educators' ratings and descriptions of STEM students' soft

skills development from the pandemic's beginning to the present. The following questions aim to support and clarify the central question. To accomplish this, the researcher used the following research question:

1. How do urban STEM educators rate and describe general student STEM interests from the pre-pandemic to the present?
2. How do urban STEM educators rate and describe student soft-skills development from the pre-pandemic to the present?
3. How do urban STEM educators rate and describe observed signs of trauma in students from the pre-pandemic to the present?

Significance of the Study

This study was designed to understand educators' ratings and descriptions of students' STEM skills from the pre-pandemic to the present. Science, Technology, Engineering, and Math (STEM) skills are often called building blocks for skills necessary in future careers, such as communication and teamwork (TeachEnginnering, 2022). As these STEM lessons become part of the practical curriculum, it is essential to understand what the students are learning. Educators see students with heightened trauma, mental health issues, and lowered academic confidence and abilities (Turner, 2022). Educators struggle to handle the amount of student trauma that can result in secondhand trauma (Lawson et al., 2019). After experiencing times of uncertainty, students have issues with multiple subjects.

Data were collected using qualitative and quantitative research methods. Narrative answers allow educators to express the issues at hand while highlighting the details of the problems that may occur in the classroom, as narratives are historically how teachers

share most of their knowledge (Clemente & Ramírez, 2008). This study provides information that can be useful in creating plans for educators to adapt better to the loss of STEM skills and increase in mental health issues and trauma.

Role of the Researcher

The researcher collected data via a survey and interviews with the STEM educators. The researcher analyzed the data similarities and differences between STEM educators' ratings and descriptions of students' soft skills development from pre-pandemic to the present. These data will be used to make inferences about STEM students' application of soft skills in the classroom. The survey was administered through an online instrument, Qualtrics, and one-on-one interviews were conducted with the researcher. There may be variations in the type of school the educator is experienced in, such as public, private, or charter schools.

Assumptions, Limitations, and Delimitations

The study assumed that all participants teach urban, low-income students with limited access to quality education and often come from families with the same circumstances (Science Education Resource Center, 2018). These students have historically struggled to obtain equal education despite numerous legislative movements to counteract them (Ramsey, 2017). The study also assumed that the participating educators experienced virtual education through the COVID-mandated lockdowns, as most states mandated or recommended closure from March 2020 through the remainder of the school year (Education Week, 2020).

A limitation of this study was its reliance on participants who volunteered to take the survey and met the requirements of teaching pre-pandemic and current. Additionally,

some participants may have earned a promotion, moving them out of the classroom and into an administrative role. The sample included these educators to ensure their experience before the pandemic (Rosborg, 2022). However, the results may be skewed by including administrators due to a lack of classroom exposure when not in a teaching assignment.

A limitation of the study was that teachers who participated in the United States experienced a shortage of teachers at the time of this research (Nathanson, 2022). This may pose a problem because finding educators who have been teaching since the pandemic to this point in the current pandemic may be complex in the outlined Midwestern urban schools. Another limitation is the national average of time an educator spends in urban schools before leaving, which averages three years (Kamrath & Bradford, 2020). The researcher hopes to compare the education year of 2018-2019, as it was the last year unaffected by a global pandemic, through the 2022-2023 school year, where almost 50 million students are back in an educational setting (Vestal, 2021).

Another limitation of the study was the differences in school typology, such as in public and private schools. This can introduce conflicting variables that may skew the results. Schools' socioeconomic status is also a limitation due to resource differences, teacher quality, and general student demographics. These factors can influence education and impact the study findings' generalizability. Without control over participants' school differences in typology and socioeconomic status, it can be challenging to determine whether the results and perspectives of the educators are due to the study's variables or are caused by the more deeply rooted uncontrollable circumstances of the individual schools.

Definition of Terms

The following glossary provides operational definitions for defining the vocabulary used in this study:

Childhood Trauma: An emotional or mental scar left by a moment of extreme stress to the mind or body (SAMHSA, 2023)

Coronavirus (COVID-19): SAR-CoV-2 was found in late 2019 in Wuhan, China, and is part of a more prominent coronavirus family (Centers for Disease Control and Prevention, 2022).

Educator: A person in the educational setting who aids in a student's educational process (Oxford Dictionary, 2022).

Interest: The term interest refers to a psychological state of getting an adequate reaction to any topic of focus (Teachmint, n.d.)

Likert Scale: A numerical scale that can help define an emotion or judgment in an asked question (Brown, 2010).

Low Income: A person or family whose typical earnings are lower than others (*what is meant by "low-income individuals"?* n.d.).

Mandated Shutdowns: Beginning in March 2020, this period required the closure of businesses and organizations not labeled by the government as "essential" for human survival, such as grocery stores and mail services (Centers for Disease Control and Prevention, 2022).

Mandated Quarantine: A 14-day period after exposure to COVID-19 to allow the virus to either leave the body or present with symptoms. If symptoms were present, quarantine

would be prolonged until the virus passed (Centers for Disease Control and Prevention, 2022).

Midwestern United States: A census-defined region that includes the north-middle states of the United States, which provides for "Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin." (Encyclopædia Britannica, n.d., p. 1).

Narrative Methods: Words, stories, or lessons convey messages (Bellack, 1998).

Pandemic: a problem that affects a large area of the world and can include the world as a whole (*Pandemic definition and meaning,* 2022).

Qualitative Research: A study using words to express emotions and experiences (Sharts-Hopko et al., 2022).

Quantitative Research: uses numbers to create a data-backed analysis and generalization (*Organizing your Social Sciences Research Paper*, 2022).

Soft Skills: Traits usually focus on personal abilities such as leadership, responsibility, and time management (International Bureau of Education, 2016).

STEM: Science, technology, engineering, and mathematics as interdisciplinary subjects (Jolly, n.d.).

Urban: Geographic areas surrounding significant cities comprising minority populations, such as people who identify as Black, Hispanx, Pacific Islander, Asian, and mixed (Watson, 2020).

Organization of the Dissertation

This study consists of five chapters. Chapter One will establish the importance of STEM education in urban schools in the current and post-pandemic world. Although

some recent studies have examined how students in urban areas typically struggle more when returning to school compared to students from different demographics, there is little to no research regarding whether mental health and trauma or STEM skills are factors in this struggle (Engzell et al., 2021; Kuhfeld et al., 2022; Najarro, 2022; Turner, 2022). Chapter Two is a current literature review focusing on STEM's key characteristics and importance, COVID's effect on students' physical and mental health and resiliency, and urban students' relationships with trauma and academic success.

There is currently an understanding of the importance of the five key characteristics of STEM education (Jolly, 2014). COVID-19 also affects the world, classrooms, and students' mental and physical health (CDC, 2022). Urban education includes the most at-risk students, and statistics regarding urban students are presented in Chapter Two (Martin, 2015). Chapter Three will focus on the study's methodology, design, and procedure. Chapter Four organizes and analyzes the data collected to be presented in words and graphics. Chapter Five will encapsulate this information into a discussion, considering the study's results and pre-existing data.

Chapter II

Review of Literature

Science, technology, engineering, and mathematics (STEM) have become increasingly important owing to the growing number of careers in related fields. STEM careers require new soft skills that can benefit day-to-day lives beyond the educational system (Navy et al., 2021). Anne Jolly describes a STEM classroom as an environment full of teamwork, collaboration, free-thinking, problem-solving, and often- noise (n.d.). These classrooms, full of new education, have vital characteristics that can enhance students' life skills. The STEM curriculum stands out compared to singular subjects and classes, as it often involves using cross-disciplinary lessons that allow students to think creatively (National Inventors Hall of Fame, n.d.). This newfound use of technology during unprecedented times has given educators more opportunities to reach students in new ways (Herold, 2022). One study found that pandemic-induced stress leads to decreased resiliency. However, the same study found that those previously exposed to traumatic events and higher levels of socialization had higher resilience levels during the pandemic (Gizdic et al., 2023). STEM education and its plentiful benefits were halted during the coronavirus pandemic in 2020, thus causing trauma and newfound resiliency among students (Jeong & González-Gómez, 2021).

Features of STEM Curriculum

Numerous components exist that help make a STEM classroom successful. The five main characteristics of STEM lessons are critical for inclusion in a curriculum unit. The first of the five main attributes of STEM lesson plans is that they use examples of real-world problems (Jolly, 2014). Creating lessons on real-world problems allows

students to focus on genuine issues related to their own lives. This application process helps solidify students' problem-solving skills (Ruddy, 2014). Students may help solve a problem that affects their community, which could relate to something or somewhere they see daily. An example of a real-world problem could be the design of a new bridge to replace an older bridge in the community.

Jolly (2014) identified the second characteristic of STEM lessons, noting that each class should include a hands-on aspect to help students understand the learning objective. Hands-on learning increases students' retention and growth of knowledge and abilities (Arnholz, 2019). Hands-on experiences allow students to build and/or experiment with physical components that advance the lesson through action-oriented education and lead the activity to follow the Engineering Design Process (EDP).

The inclusion of the EDP is the third characteristic and is a process that allows students to explore real-world problems through creative solutions and innovative thinking. EDP will enable students to work through difficulties and reattempt when something does not work as expected. Students can also be creative and work on teamwork. These skills help students learn to deal with issues that are most likely to arise in a natural job setting (TeachEngineering, 2022). Using the suggested project, the students could build a bridge using the materials provided, test the weight capacity, and then try to increase the bridge's weight each time.

Teamwork is the fourth key characteristic of STEM lessons, as it is a lifelong skill (Hefty, 2015). Activities within typical STEM curricula, such as robotics and coding, demonstrate strength in teamwork skills to accomplish a significant goal (Çalişkan, 2020). These processes allow students to lead in learning, the fifth and final

characteristic. Students with a say in their education are typically more engaged, leading to better grades and understanding (Wagoner, 2019). Teamwork fosters honesty when working with others and knowing how to create a mutually respectful workspace (Kanyarusoke, 2017).

Along with these essential characteristics, STEM encourages inquiry-based learning. This is how individuals learn how to push themselves to answer questions they might have with little guidance from their educators or the people within a school to educate students (Oxford Dictionary, 2022). When students use open-ended thinking to accelerate their education, they begin an inquiry-based learning process in which educators allow students to learn from their questions (Jolly, 2014). Students learning through inquiry-based learning have outcomes with better organizational skills and analytical thinking and even have a better overall understanding of scientific concepts within other disciplines, such as technology or math (Panasan & Nuangchalerm, 2009).

By contrast, educators gently guide students to critical points (Alper, 2018). Inquiry-based education is beneficial, allowing students to learn essential life skills, such as identifying problems, creative problem-solving, and logical thinking (Fischer, 2022). Students working on an individualized learning plan created through their inquiry-based model often see significant grades increase as they are more inspired to solve the problem (Pane et al., 2017). The vital characteristic that students need to learn and practice applying for real-world use is how to persevere through failure. Students often shy away from anything that seems too difficult. The EDP encourages students to learn how to tackle and solve intricate problems. Perseverance is taught through inquiry-based learning, making problems seem easy to solve (TeachThought, 2022). When students

learn to work in more situations, they will likely have higher self-esteem (Dweck, 2016). Inquiry-based learning provides students with a constant desire to grow intellectually, thus mimicking the meaning of malleable intelligence. Dweck states ("[students] who are led to believe their intelligence is a malleable quality begin to take on more challenging learning tasks and begin to take advantage of the skill-improvement opportunities that come their way" (2016, p. 26). Through inquiry-based learning, students can use logic and problem-solving to grow and look for a more significant challenge.

To further examine the importance of perseverance and children's self-perception of ability, Dweck (2016) discussed a study in which young children completed a puzzle and were presented with three puzzles beyond their capacity and a fourth that could be achieved (p. 99). The children in the study with a higher sense of self-ability completed a more challenging puzzle when given the opportunity. Children with lower self-ability repeated the easier puzzle or were asked to perform another task (Dweck, 2016). This study showed that students with higher tolerance to challenges will likely persevere through failures, a key component of inquiry-based learning and a valuable life skill.

Importance of STEM

These skills learned in STEM classrooms do more than make classwork fun and teach skills outside state standards. Completed surveys of students working through STEM mentorships show that minorities have overall improved academic success (Arment et al., 2013).

Over the past decade, the importance of STEM in classrooms has become a necessary topic. STEM education is growing worldwide because of increased STEM jobs (Feller, 2010). While few studies have fully linked STEM in K-12 schools to STEM-

based careers, Wei et al. (2013) completed a study that found that students in upper-level math classes were more likely to gravitate toward STEM-based course offerings and careers. Wei et al. (2013) conducted mail and phone interviews five times from 2001 to 2009, asking students whether their interests had changed as they transitioned from high school to college. They concluded that students in intermediate-level classes showed more interest as they grew older.

However, all ages showed extreme interest and wanted to continue the course once it ended (Wei et al., 2013). For younger students, it was found that hands-on STEM classes were favored and requested to continue after the classes had ended with the school year (Julià & Antolí, 2018). The same students' interests were not gauged in the past in STEM-based post-secondary majors or careers. However, it was found in a study completed by Dunn et al. (2018) that the self-images of students with IEPs (individualized education plans) significantly improved after taking STEM courses. An increase in positive self-image was significantly correlated with enhanced academic skills and efficacy. This increased positivity can lead to students having a heightened interest in STEM courses, which can help them in future careers. This ties into the findings of Wang (2013) that "offer(s) new theoretical and empirical knowledge that informs policy and practice intended to promote equitable participation in STEM fields of post-secondary study" (p. 1114).

The same study used data to position STEM backgrounds as influencing post-secondary students when choosing a college major. Participants in this study were asked about their interest in a STEM college major during their sophomore year of high school and then followed up with the same students in their senior year to gauge whether their

interest had changed. While the idea of students getting these crucial lessons is now identified as essential, it is also important to know what methods educators use to allow them to work best. Multiple techniques can work; knowing what works best in each classroom is critical for obtaining the best results.

High school students report a need for preparedness when working in post-secondary classes within in-depth discussions focused on the skills necessary to succeed at a post-secondary level that is difficult to teach in the required state-mandated basics (Zlatovic, 2018). These basics include teamwork, critical thinking, logical thought processes, and perseverance through failure (Hefty, 2015). These missing skills are fundamental to STEM topics and most STEM lessons (Zlatvoic, 2018).

The Coronavirus Disease "COVID-19"

The World Health Organization states that coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus" (2022, p. 1). According to the Centers for Disease Control (CDC), COVID-19 was detected in China in late 2019. The infection spread quickly through Asia and Europe from China to North America within a few months (Centers for Disease Control [CDC], 2022). In March 2020, states began to shut down schools and other public places, including Ohio (CDC, 2022). Along with shutdowns, states mandated the requirements for people to wear facial coverings and social distancing to help stop the spread of the virus. (CDC, 2022). After multiple virus variants, the world is back to normal, but COVID has not yet been eradicated. (Ulukol, 2022). People can gather indoors without mandated social distancing or masks, but cases are still being reported (The New York Times, 2020).

COVID-19 Effects on Classrooms

Educational systems scrambled to change instructions to benefit students during shutdown periods. These instructional methods include paper packets, Google Classroom, zoom classes, and, for some districts, even giving every student technology to begin online education (Cerenelli, 2020). This variance in required teaching, along with knowing how to return to the classroom and teach online, causes teachers to do more work than before, leading to teachers feeling worn out (Spiker et al., 2023). In the 2020-2021 school year, Ohio offered multiple options to attend school, from entirely in-person, fully remote/virtual, or a mix of the two (*Reset and Restart* 2022). As of February 2021, 42% of rural districts in the United States, 27% of suburban schools, and 17% of urban schools returned to entirely in-person classes (Schwartz et al., 2021).

The number of COVID-19 cases has slowed, and life is beginning to return to normal (CDC, 2022). The use of technology in the classroom has persisted even after the pandemic (Ulukol, 2022). Still, some students thrived in an educational space with more freedom over their academic path, and some students needed more motivation to log in and learn and/or needed access to technology or reliable Internet (Lekiqi et al., 2021). Although virtual education has become the choice of some schools to continue the education process, students could use technology to access education in ways they had not before. This encouraged students to work more and could often work from their phones (Graham, 2022).

Despite these different ways of completing schoolwork, it was found that students need to gain a large amount of knowledge from the time spent in virtual school. These students typically need help to return to the classroom because of the adjustment period and the missing material expected to have been taught in previous grades (Chen et al.,

2021). Only 35% of 182 students felt that they had a proper place at home to allow schoolwork to be completed, which may have contributed to the gap in knowledge (Kahn et al., 2022). More importantly, it has been found that just as educators are feared, this affects minority and impoverished students the hardest (Kamenetz, 2022).

COVID-19 Effect on the Students

Lingering effects- students, especially minorities, have been left with incomplete education for the 2019-2020 school year, as reflected in testing (Dorn et al., 2021). Academic testing between 2019 and 2020 significantly declined, especially in urban schools (Kuhfeld et al., 2023). While these effects are noted on the state tests,

Student Mental Health and Trauma. Undergraduate students registered for resource offices, specifically for mental health help, rose by approximately 59% from fall 2019 to 2020 (Aquino & Sally, 2022). Students are more likely to be exposed to mental, verbal, and physical abuse and/or violence during times of shutdown and quarantine (Ulukol, 2022). Even early in the lockdown, the mental health impacts could be long-term and severe (Brooks et al., 2020). Humans are not typically accustomed to being shut out of human contact, causing mental health issues such as depression, trauma, fear, and anxiety. (*Life in lockdown*, 2021). Students reported feeling intense loneliness, depression, and stress (Nadeem & Van Meter, 2023). A group of 12 educators and four of their students' interviews showed a common theme of desiring more interaction with their teachers and classmates (Vakil & Post, 2022).

Urban students are more likely to have experienced and been affected by trauma (Meyer & RB-Banks, 2017). The burden of stressors took its toll on 3998 students' psychological health for under-resourced students, showing an increase in symptoms

related to anxiety, depression, and post-traumatic stress syndrome between 15% and 20% over a month during the onset of the pandemic's mandated US shutdowns (Rudenstine et al., 2023). The National Child Traumatic Stress Network defines trauma as a "frightening, dangerous, or violent event that poses a threat to a child's life or bodily integrity" (Peterson, 2018). Trauma is not just a momentary threat; it can have lasting effects, such as brain damage, self-esteem issues, and self-regulation skills in everyday life (Perkins & Graham-Bermann, 2012). Even more detrimental, it has been found that trauma-related scars can be left on the brain permanently (Sandi, 2013).

Although these students struggled with their own experiences, the COVID-19 initial shutdown often saw children under 18 without proper care, support, and sometimes even food (Kamenetz, 2022). When students are in a state of worry without having the right resources, this creates stress that can be traumatic. A study conducted by the National Survey of Children's Health (2010) concluded that over half of the children, or 35 million living in the United States of America, experienced at least one traumatic event before the age of 18. The same report concluded that children with trauma experienced even more traumatic events, leading to mental and/or physical health issues as adults (National Survey of Children's Health, 2010). This exemplifies how trauma is carried throughout life and can become a barrier to learning (The Learning Hindrances of Stress and Trauma, 2019). Studies have proven that students who learn about theories, such as the incremental theory of intelligence, struggle less with preconceived notions about how they can grow with the help of a total mindset of educators (Dweck, 2016).

Students' Physical Health. Physical issues affecting students came from violence at home but also from the increased amount of screen time. Students using technology

more than usual are starting to report eye-staring, causing near-sightedness issues (Wong et al., 2020). Students also struggled to get proper sleep as, without a set schedule, they would sleep whenever and stay up at any hour (Bruni et al., 2022). The lack of sleep can cause long-term problems such as anxiety, sleep terrors, poor physical health, and even post-traumatic stress disorder (PTSD) caused by the stress of COVID-19 (Bruni et al., 2022). Along with poor sleep and eyesight, students are also at risk of exposure to violence inflicted on their families (Humphreys et al., 2020). Students' risk of becoming victims of violence inflicted by a family member significantly increased as students stayed home. These events can be linked to stress, anxiety, and PTSD (Humphreys et al., 2020). Due to the mental stress from returning to school, students are turning to acts of physical aggression, such as acting out in class and bullying, and more are attempting suicide (Vestal, 2021). A 2020 study found that children under 18 were approximately 20% more likely to experience symptoms of depression and anxiety shortly after mass COVID-related shutdowns (Nearchou et al., 2020).

Resiliency

Resiliency is the practice of moving past hardships experienced by one person, and some minorities already exhibit trauma in the form of long-term stress. Students with academic achievement typically show higher resilience (Burton, 2020). Resiliency is a common theme among students with these experiences, and some minorities exhibit trauma in the form of long-term stress (Lamb et al., 2021). Students who exhibit resiliency are often those surrounding students, such as families, educators, and the community. This support is offered through mental and physical health and the general

well-being of students (Evans-Winters, 2011). Additionally, the most resilient students use community resources to their advantage (Evans-Winters, 2011).

During the COVID-19 shutdown, cities with greater access to public resources showed more stable health records, supporting resilience (Apostu et al., 2022). Some early studies have shown that the highest score of urban resilience to deal with the pandemic was for those with strong ties to their communities (Ningrum et al., 2022). However, some communities with lower socioeconomic status needed help to sustain the necessary change to provide beneficial services during the initial shutdowns (Ningrum et al., 2022). Supporting youth who express these feelings to foster resilience requires a better and more precise understanding of implementing systems that offer support accessible to all students in the short and long term (Nadeem & Van Meter, 2023). Early findings reporting youth in urban communities claimed that technology was monumental in establishing some sense of normalcy, which helped build aspects of resiliency (Ningrum et al., 2022).

Urban Schools

Schools differ nationwide. One of the most prominent differences students are predisposed to is whether their school is in a rural, suburban, or urban area. Urban areas are minority populations, such as people who identify as black, Hispanx, Pacific Islander, Asian, or mixed and are geographically located close to major cities (Watson, 2020). These urban schools consist of a minority of students. They are at risk of many issues that students in rural areas often do not face, with family income being a factor in their livelihood (Martin, 2015). Approximately 49% of children live in poverty or low-income homes nationwide (Understanding the Impact of Trauma and Urban Poverty on Family

I*nterventions*, 2018). Schools typically mirror the economics of their areas, which can lead to funding and educational opportunity inequalities. For example, Illinois's funding structure draws funding away from schools based on uncontrollable factors, such as school choice and county vouchers, which were further hurt during the shutdowns (Martin et al., 2022).

These urban students are likely to have lower grades, affecting their grade point average (GPA), which is used to decide enrollment in most post-secondary opportunities (Slade & Wissow, 2007). Most recently, minorities within urban areas are more likely to contract COVID than most white people (Bonilla-Santiago, 2021). Similar health issues affecting minorities in urban communities include an increased likelihood of experiencing health issues such as diabetes and serious infections (Peters, 2020). These urban students are also more likely to have been affected by lifelong traumatic events caused by abrupt nature and sudden changes in pandemic-induced shutdowns (Burke et al., 2011). Females in low-income areas were more likely to experience severe stress, with 88% of 2691 university students in a nationwide online survey during the pandemic (Lee et al., 2021). Students in diverse types of schools have diverse cultures, which can cause a lack of individually recognized students due to generalization (Love, 2020). Schools are focused on reform with set goals addressing culture and are too heavily focused on standardization. This misplaced focus furthers inequality by leaving students without proper resources for equal education, especially as the general cost of educating each student increases (Cristea, 2019). This generalization, standardization, and pandemic have driven students away from educators (Bjerede, 2013). The best way to bring students back into the classroom with a sense of belonging is to create a relationship with

them (Hendershott, 2016). This relationship can be established by acknowledging personalities and how students express themselves without tying their academic success to who they are (Hendershott, 2016).

Without these established relationships and a sense of belonging for these students, the trend shown in the United Nations reports will continue to offer increasing numbers of high school dropouts at alarming rates, with the standard percentage of dropouts rising from 15% to close to 60% (United Nations, 2020). This may be attributed to urban schools being less likely to be back in person during the 2020-2021 school year or the lack of support from families within urban and suburban areas (Schwartz et al., 2021). The most affected are the "disadvantaged and marginalized" students, who should be targeted as students of concern. Trauma students are more likely to return to the classroom (Landsman, 2008). In a pre-pandemic world, these targeted students will likely experience the pandemic's negative and possible life-long repercussions (Fegert et al., 2020). This disruption to schedules caused by school shutdowns caused students to keep themselves and struggle with adapting to the change, negatively affecting their mental health. (Lee, 2020). The lack of equality and equity for black students went as far as within the Florida Foster Care System, as children within the system were less likely to be placed with families during quarantine because of a lack of proper families that could deal with the mental health issues these students had developed (Katz & Fallon, 2021).

Urban Trauma and Academic Success by Biologic Gender

Urban female students are more likely to have experienced traumatic events, such as domestic violence, and report post-traumatic stress disorder (PTSD) symptoms following those events (Horowitz et al., 1995). In a pre-pandemic study of 83 teenage

urban girls, researchers reported that 92% of participants had experienced at least one traumatic event in their communities or homes (Lipschitz et al., 2000). Although urban female students were less likely to report experiencing any symptoms of long-term emotional distress, signs of short- and long-term emotional distress were examined following traumatic life events (Ick et al., 2016). Female students with traumatic pasts typically perform better in trauma-informed settings and are more receptive to learning (Crosby et al., 2019).

There is a great need for safe places for black girls in scientific and academic environments (Wright & Riley, 2021). Additionally, early studies suggested that strong positive peer relationships create systems of support, fostering resiliency. Thus, communities, families, and schools need to assist in promoting long-term positive relationships between girls and their peers (Evans-Winters, 2011). One way to create a safe place for these Latina girls is to use native languages, which creates a safer place to encourage the pursuit of STEM fields (Stevenson et al., 2017). During the pandemic, it was found that urban girls scored higher on a resiliency skills questionnaire than did urban boys (Toor & Kang, 2023).

Urban male students are more likely to experience or witness a violent crime than any other adolescent group and are predisposed to higher rates of community violence (Berton & Stabb, 1996; Miller & Wasserman, 1999). The same boys were less likely to have positive relationships with peers in their classes (Blanton & Smith, 1993). These hardships can create barriers in students' lives, as graduates typically recall greater importance assigned to education during childhood (Williams, 1987). Boys can be

positively affected by lessons with empowerment themes, as shown in a 2013 study, thus encouraging education and personal growth. (O'Neil et al., pg. 202.)

Urban male students are less likely to continue working on STEM lessons without guided instruction, leading to a lack of academic success (Marshall et al., 2011). Urban schools often need proper funding for materials that allow innovative STEM lessons, especially in math, which is vital for creating a strong STEM interest in young urban males (Davis & Farran, 2018). The same urban male students reported microaggressions in STEM courses and clubs based on race or background (Grossman & Porche, 2013). Creating safe places for all students of race and gender from an early age allows males to thrive in STEM lessons, motivating them for future academic endeavors (Nasir & Vakil, 2017). Despite the need for guidance, male students are still more likely to earn a degree in a STEM field and are likely to have average grades in high school STEM discipline classes, while girls who enroll in those majors typically had above-average success in those topics (Sparks, 2021)

Summary

Recently, the focus on the effects of teaching and education needs to be addressed. Education is changing and challenging as educators observe students struggling with pre-pandemic and pandemic-caused stress. These students were anxious and uncertain, even as the world began to return to its pre-pandemic state. Urban schools already enroll students with higher levels of stress experienced in everyday life and are now juggling pre-existing problems with unfamiliar problems created for them. As the pandemic was a novel time, full of uncertainty, it is apparent that students are returning to the classroom with the highest levels of stress that no educator has experienced. Thus, educators must

prepare to provide the proper understanding and coping mechanisms. Educators struggle as much as students, and many are leaving the profession in record numbers (Davis et al., 2021). Educators are asked to add more social-emotional learning to lessons to fill the missing learning gap while students are out of school (Schwartz et al., 2021; Davis et al., 2021). STEM educators must focus on state standards and embrace STEM's key characteristics. As students are encouraged to distance themselves from each other socially and often recuse themselves from everyone, asking a student to work in a team is an impossible task.

There is a noticeable gap in the educational skills of students from the late 2020 school year until the end of the 2021 school year (Dorn et al., 2021). Educators must plan to get students back on track while encouraging mental and physical healing. The United Nations International Children's Emergency Fund (UNICEF) prioritized getting students back up to standard and focusing on basic skills that can be taught through STEM classes. By focusing on basic skills that can get students back to their point, educators are trying to evolve to meet the modern needs of these classrooms. STEM lessons, such as inquiry-based education and critical characteristics, closed the gap between students and educators caused by the pandemic and prepared students for the world they will contribute to (Deák et al., 2021). However, without a proper study to identify the changes in crucial classroom characteristics, educators will be going through a trial-and-error period that could have an unknown effect on the mental health of students and educators' (George et al., 2021). Educators can change their education path, creating more resilient and equitable classrooms (Chen et al., 2021).

Resilient and equitable classrooms can have many different shapes and sizes. During the onset of the pandemic shutdowns, students are forced to adapt to changes as they are announced, creating resilience (OECD, 2021). Learning differences during the pandemic forced students to change how they learned. Students found ways to handle difficulties independently or with the help of adults supporting them, such as educators and parents. These techniques include yoga, slow breathing, and reaching friends for a break (Goralnik & Marcus, 2020). Goralnik and Marcus also found that seven percent of students struggled to achieve academic achievement, even using meditative methods (2020). However, these students found ways to organize their education, such as scheduling or emailing a professor. (Goralnik & Marcus, 2020). Even when educators are unsure how to teach resilience, it is still critical to create a safe space or at least one that does not advance mental health issues within students (Korinek, 2021). Resiliency does not need to be a lesson; it comes through human understanding, embracing personalities within the classroom, and kindness (Souers & Hall, 2016).

The most apparent fact from the COVID-19 academic shutdown is that education is not ‘one-size-fits-all’ (George et al., 2021). Educators embrace the opportunity to explore new methods for students to learn (Concordia University Texas, 2022). Many skills are included in STEM classrooms, such as the five key characteristics (National Inventors Hall of Fame, n.d.). One of the most critical skills that is indirectly learned is that speaking for oneself is the key to achieving self-actualization (Maslow, 1967). Finding oneself in the classroom can create a sense of self-motivation that benefits real-world applications (Maslow, 1967). A secondary outcome of STEM lessening and the pandemic is the rise of technology within the classroom (Concordia University Texas,

2022). In conjunction with skills learned through STEM, different methodologies within the lesson allow choice for students to understand the information being taught in a way that benefits the student through engagement and a sense of ownership in their education (Pandolpho, 2018)

These classrooms could change the course of our education system and produce more caring school systems through connections with modern therapy-adjacent practices (R. B.-Banks & Meyer, 2016). Social-emotional learning is a way to connect therapy to STEM lessons with the benefits of increased graduation rates, fewer behavioral issues, and better GPAs (Bushnell & Card, 2003). Turner et al. (2022) state:

> (The need for a) call to action for empathetic teaching, learning, and policy approaches focusing on student learning and support. We contend there is a greater need to value learning as a lifelong cognitive, social, and ethical development process. Such an approach empowers students to focus more on becoming the best future science professionals rather than viewing science courses as a hurdle to overcome concerning their career endeavors. (p. 336)

In Bettina Love's 2020 *We Want to Do More than Survive*, Love states that it is necessary for educators to ignore what has been done in the past and to move into modern education that does not forget color but embraces and celebrates it (pg. 102). Teaching respect for each other's ideologies and cultures, primarily through native and appropriate channels, can create an equitable educational system (Murray, 2021). Teachers with proper training in culturally responsive teaching handle culture within the classroom more easily and tactfully (Acquah & Szelei, 2020). Recent findings suggest implications for partnerships with the community, and digital applications can promote collaborative

and culturally relevant STEM learning opportunities post-pandemic (Kier & Johnson, 2022). These ideas of diverse education and empowering historically repressed people within urban communities paired with essential life skills, empathy, therapeutic understanding, and modernized education can shrink the growing learning gap during the pandemic. When educators embrace STEM education, the learning gap can be reduced by engaging in real-world lessons, hands-on education, inquiry-based education, and life skills taught through actual applications.

Chapter III

Methodology

Students' science, technology, engineering, and mathematics (STEM) soft skills are necessary as they increase their aptitude for future careers (TeachEngineering, 2022). Interpersonal interaction is an essential way of developing soft skills. The pandemic has led to fewer face-to-face interactions for students and more trauma-causing events in students' lives, especially in urban communities (Schwartz et al., 2021). This two-part mixed-method study aimed to identify and understand how Midwestern urban school districts' educators rate and describe students' general STEM interest and application of soft skills from the beginning of the pandemic to the present, along with the observed signs of trauma in classrooms.

Chapter Three of the proposal includes the methods, participant sample, role of the researcher, data collection/instruments, data analysis, validity/limitations, and ethical considerations. The Chapter concludes with a summary.

Research Questions

This mixed-methods, descriptive study aimed to understand how Midwestern urban school educators rate and describe STEM students' soft skills development from the pandemic's beginning to the present.

The research questions for this study are as follows:

1. How do urban STEM educators rate and describe general student STEM interests from the pre-pandemic to the present?
2. How do urban STEM educators rate and describe student soft-skills development from the pre-pandemic to the present?

3. How do urban STEM educators rate and describe observed signs of trauma in students from the pre-pandemic to the present?

These questions need to be answered as the 2020 pandemic was unprecedented, and due to its novel nature, its effects on students have yet to be studied.

Research Methods

The initial survey used Likert scales, multiple choice, and open-ended questions in Part A to establish and confirm the primary themes. Part B of the study used one-to-one interviews, which were analyzed through thematic coding. These research methods are considered mixed methods. The methodology used in this study was a case study. The researcher completed the study within the defined and developed criteria (Merriam & Tisdell, 2017). The participants were Midwestern urban school educators.

The explanatory sequential design mixed-methods methodology was chosen as the most appropriate method for data collection (Merriam & Tisdell, 2017). Numerical ratings aided in determining differences, and the open-ended questions collected more detailed reasoning for the ratings in Part A of the study. Part B of the survey collected more detailed responses regarding the details provided in Part B. A baseline was established in Part A through the quantitative method of using a Likert scale and multiple choice to rate students' general interest in STEM classroom lessons, student soft-skill development, and application, and observed signs of trauma from the 2018-2019 school year. This baseline was compared to the ratings given by the same educators for the 2022-2023 school year. The most appropriate method of collecting data in Part B was interviewing participants and using open-ended questions because this study explored educators' perceptions of students. Using a basic qualitative design, the researcher

gathered data from midwestern urban educators about their understanding of student changes between 2018 and 2023.

Participant Sample

The participants in this study were Midwestern urban educators with pre- and current pandemic experience, using the 2018-2019 school year and–2022-2023 school years as comparison years. Educators included those on teaching assignments (STEM of STEM adjacent), instructional aides, members of the administration, or anyone who has interacted with students academically since at least 2018. The total sample size in Part A of the study was 42 urban educators. Ten of those 42 then engaged in one-on-one interviews in Part B.

Part A participants were required to teach STEM- or STEM-related topics in Midwestern US schools. Initially, 55 surveys were turned in; however, 13 were incomplete and were omitted from the analysis, leaving 42 participants in the study. The survey questions and interviews were not required to allow educators to avoid discomfort. Because of this, Part A's survey responses ranged from 32 to 38, and Part B saw all 10 participants answer all the questions.

Nonprobability sampling was used to select educators who met the requirements of having been in the education realm before the current pandemic and working in a Midwestern urban population. Nonprobability was the most appropriate sampling method, as the participants had a list of requirements to meet and were chosen by the researcher depending on their qualifications. Snowball sampling increased the number of participants asked to share the survey with anyone who met the study criteria. (Merriam & Tisdell, 2017).

Participants answered the survey questions using Qualtrics. Participants were identified according to their school districts. The researcher contacted different urban schools throughout the Midwest and asked for the survey to be shared with staff. These districts then shared the study with those that met the criteria. Each participant signed an informed consent form before participating in the survey for Parts A and B of the study. Informed consent was part of the digital survey and would not allow participants to continue without first agreeing to informed consent. After the initial responses were analyzed, the interviewees who provided details in the open-ended questions on the survey were asked to participate in an interview. Ten educators agreed to participate in follow-up interviews.

Role of the Researcher

My STEM-based classroom experience led to a consistent observation of the increased interest in typical STEM lessons, decreased application and development of soft skills, and increased signs of trauma in students once returning to the classroom after mandated shutdowns. I currently work in a dropout prevention and credit recovery district. Our students typically come to us when more public schools need to work out for them. We used trauma-informed methods and scaffolding to reach students where they were. However, in my ten years of education, the past three years have been heartbreaking. Students with odds stacked against them need help with material significantly above their comprehension level. It is necessary to establish how difficult the pandemic has created the typical educational process for these students.

Although this study aims to unearth the connections between soft-skill development and pandemic-era remote instruction, it is essential to recognize personal

bias and prevent it from influencing data collection and analysis. Upon approval to begin the study, permission was obtained from the midwestern urban school districts. The survey was shared with the administration and STEM-related teachers if the school district approved the proposal and the study's goals. Data were collected without prior interaction with the researcher to avoid influencing the study setting. To ensure that the authentic voice of the participants is heard, various safeguards, such as member checks, will be implemented. To safeguard participant identities, participants will be identified by the city where they teach and their position within the school to minimize bias and protect personal identities. Participants will be informed of all the research risks and how their responses will be used. Although there is minimal risk, the potential risks will be explained. Those who agree will sign a consent form, which is included in the survey and must be agreed to continue the study.

The data were reviewed for completeness after 55 participants had submitted their surveys. The 13 surveys that provided no quantitative or qualitative data were excluded. The 42 remaining surveys were analyzed. Likert scale items were averaged and compared between the 2018-2019 and 2022-2023 school years. Multiple choice questions were analyzed using t-tests and comparison graphs. Open-ended questions were analyzed using thematic coding. Seventeen of the 42 participants who answered the open-ended question in detail were asked to participate in a video follow-up interview using Zoom. The ten participants who agreed were asked the same questions, and answers were recorded, which was Part B of the study. The researcher looked for thematic coding within the recorded interviews to find similarities in the experiences of each participant. These data were compiled into common themes based on the features of STEM in

classrooms and the common observation differences in post-pandemic STEM or STEM-related classroom lessons.

Data Collection / Instruments

The researcher used mixed methods for the data collection. Data were collected using a triangulated data-collection strategy. This study included an initial survey (Part A), follow-up interviews (Part B), and a review of documented data regarding pre-pandemic STEM soft-skill achievements.

The techniques used to collect the data consisted of a Likert scale of one through five surveys paired with written open-ended questions to gather initial data. A rating of one represents an observation of a student who is low in general interest, application of STEM soft skills, or signs of trauma in the classroom. A rating of three is a median, mostly answering some observed general STEM interest, STEM soft skills, or signs of trauma. A rating of five represents a high rating of general STEM interest, high application of STEM soft skills, and high observed signs of trauma in the classroom. Once these initial data were collected using an online survey service, Qualtrics, the data were analyzed. As the initial survey captured data from pre-pandemic education to current-pandemic education, the initial analysis of the data helped identify those who answered with Likert scale numbers with the most significant variations in students' STEM soft-skills development, from pre-pandemic to present. Those whose scores reported more significant differences with STEM soft-skill development were then interviewed to help better understand their perspectives on students' STEM soft-skill development during the pandemic.

The interview questions were created using the initial research categories. These categories include the importance of STEM education and related soft skills, urban education disadvantages, effects of trauma on education, and pandemic effects. Each category featured interview questions that led the participants to focus on each area and how it relates to the study. The questions are as follows:

STEM education and related soft skills:

- STEM has become a subject of growing importance over the past decade. Can you provide examples of your STEM lessons and how students receive them?
- It has been said that the STEM field requires more hands-on work and critical thinking. How did/do your students react to using aspects of STEM in the classroom?
- The pandemic significantly affected educators, as every lesson was taught. How did you teach those same STEM soft skills during 2020's shift to virtual education?
- Do you feel like STEM activities have changed in the classroom since the pandemic? Do students engage in the same activities during these lessons as they did before?
- Virtual education became the vehicle for academics during and in current-day classrooms during the pandemic. Has the enforced use of technology affected students' ability to become engaged with STEM lessons?

Urban education:

- There are stigmas around teaching in urban schools. What are the biggest challenges for you as a teacher in urban schools?

- Given the challenges mentioned, how do other aspects of their lives influence these students? Please give insight into home life, hobbies, attendance, IEP/RTI intervention frequency, or anything else you have observed. Have these challenges changed compared to the 2018-2019 school year?
- No two students are alike and often come into the classroom with a predisposition toward learning. What is your student's general attitude toward learning?

Effects of pandemic-mandated shutdowns:

- After mandated shutdowns, students had to re-learn how to be in the classroom. Since returning to the classroom, what changes have you seen in the students?
- Students thrive on constancy; in some cases, teachers are the only constancy a student may have, leading to a trusting relationship. Do students in your classroom tend to share their subjective experiences, trauma-related or not, openly with you or during class? Do you think your students usually trust you?
- Students who have experienced trauma can be reluctant to interact with new people, such as educators. Please examine if you have experienced any withdrawn students for whom trauma was an issue.

Pandemic effect on education:

- Many schools turned to virtual education during mandated shutdowns. How did the overall virtual class meeting time feel for you? How much did you have to change the curriculum to keep students engaged?

- Most schools have returned to physical classrooms during the 2022-2023 school year. During your first full year back with students face to face, were there any new challenges you or your students faced due to the transition back to the classroom?

Data Analysis

There were two parts of the data analysis in this study: Part A, which included an analysis of the Likert scale and multiple-choice questions on the survey, as well as an analysis of open-ended survey questions using the six steps of thematic coding as defined by Terry et al. (2017), and Part B with also used the six steps of thematic coding. The initial survey responses were analyzed using means, comparison charts, one-sample t-tests, cross-tabulation, chi-square tests, and a six-step thematic coding process. The responses to Part A to the open-ended questions and the interview data were coded according to the original research categories. This allowed any emergent information to be identified.

Part B of the study collected data through virtual interviews. The data was coded and analyzed as the interviews were conducted. The early analysis allowed the research to identify early themes and commonly used phrases. Each commonly used phrase was placed into one of the five initial categories to analyze the data thoroughly. The researcher coded any data that did not fit into one of the five categories as a different theme that may or may not have emerged as a category. Each category has a different theme- the first five categories are based on Jolly's definitions of STEM characteristics, and the sixth category is related to trauma (2014).

Ethical Considerations

This study focused on the reported responses of the human subjects. The Institutional Review Board (IRB) reviewed and approved the research method. The IRB of Youngstown State University is responsible for reviewing and approving research involving human subjects. However, there was minimal potential for negative repercussions for participants in the study due to the lack of requested personal information. The safeguards were in place to protect all participants. All participants will be informed of the nature of the research regarding education during the pandemic and how the results will be used to conclude any relationship between possible pandemic-influenced changes in STEM interest, STEM soft skills, or observed signs of trauma. Participants will be named using the term 'Urban Educator,' and the researcher will assign a number randomly. After the study's conclusion, these participants were informed of how data was and will continue to be kept on the researchers' computers in a file with a two-factor verification password system with complete deletion from all systems. Before any participant can sign the consent form, it will also be made clear that at any point in the study, any participant may withdraw responses without question.

Summary

This two-part study examined the effect of the 2020 pandemic on urban students and their STEM-related soft skills through ratings and descriptions of STEM soft skills in pre- and current pandemic classrooms and observed signs of trauma in the classroom. This case study approach used mixed methods of data collection and analysis. Participants included 42 midwestern urban educators who have taught from 2018 to the present and will be selected through nonprobability sampling. The data was analyzed in three parts. The first part examined Likert-scale and multiple-choice questions. These

questions were analyzed using t-tests, means, and cross-tabulations. In Part 2, open-ended questions from the survey in Part A of the study were analyzed using thematic coding. This thematic coding method used six sets to identify common sayings and themes and was also used in Part B to identify any relationships in the Likert-scale questions. Part 3 of the study consisted of interview questions from Part B of the study. Before obtaining consent, the participants were informed of all potential risks and how the study would be used.

The limitations of this study include a need for more educators in modern classrooms. As the shortage of teachers worsens, teachers who had seniority may have been promoted during the mandated school shutdowns, leading to the inclusion of administrators in the sample, which may have skewed results. This was accounted for by including “educators’ taking the survey rather than just teachers. These educators were all Midwestern United States-based; therefore, the chance of lower numbers due to the resisted geographic region is possible. There was also a concern for educators who would rather not discuss the pandemic classroom, as it was a time of turbulence for all those involved. However, most educators were eager to share their experiences during open-ended questions in the survey and interviews.

Chapter IV

Results

This mixed-method study assessed Midwestern urban educators' ratings and descriptions of students' general STEM interest and soft skill development and observed signs of trauma in the classroom from the pre-pandemic 2018-2019 school year to the 2022-2023 school year. This study employed a case study methodology. Quantitative data were gathered through a survey administered to 42 STEM- or STEM-related educators or administrators featuring Likert-scale questions in the initial survey in Part A. Qualitative data were obtained through open-ended questions in the survey and supplemented by ten follow-up interviews, providing more detailed insights. This study aimed to answer the following research questions:

1. How do urban STEM educators rate and describe general student STEM interests from the pre-pandemic to the present?
2. How do urban STEM educators assess and characterize students' soft skills development before and after the pandemic?
3. How do urban STEM educators evaluate and depict the observed signs of trauma in students before and after the pandemic?

The findings presented in this chapter answer the study's research questions by using participant surveys and interview data. All information presented was subjective to the participants and their students' perspectives during the two critical school years. This chapter presents the themes and findings of the study. The study's findings emerged from the t-test, means, and data analysis cross-tabulation in Part A of the study, using thematic coding for open-ended questions. This thematic coding method, which uses six sets to

identify common sayings and themes, was also used in Part B. This chapter includes an introduction, a description of the participants, findings, and a summary.

Participants

Nonprobability sampling was initially employed to select urban Midwestern STEM or STEM-related subjects (such as math or technology) were educators and administrators who met the criteria of having worked in the education sector both before and during the pandemic (specifically, during the years 2018-2019 through 2022-2023) and were currently employed in urban school districts in the Midwest. This method was chosen because of its convenience and practicality, allowing for the quick selection of participants based on readily available information. School districts were selected using the 2020 United States Census Data, as the agency published a list of Urban Cities by State. The states defined as Midwestern in Chapter 1 were used, and cities were identified as urban. The identified urban area school district websites were used to obtain the contact information. The researcher sent invitations to these districts to participate in the survey.

Following the initial selection, snowball sampling was used to increase the sample size. This approach involved asking initial participants to refer to other educators who met the criteria. By leveraging the networks and connections of the initial participants, snowball sampling facilitated the recruitment of additional educators. This study consisted of two parts: Part A involved participants completing the survey, and Part B involved conducting interviews with a subset of participants selected from those who participated in Part A.

Study Part A: The Survey

Part A comprised seven personal identification questions, six Likert scales, six multiple-choice questions, and three open-ended questions. It was disseminated to both public and private Midwestern urban school districts. The survey was sent to the principals of the schools within the district unless their school websites listed contact information for research inquiries. School districts shared the survey with relevant staff members meeting specific criteria: educators teaching or working in urban schools since at least 2018, primarily taught STEM-related subjects, and continued working during the COVID-19 shutdown in 2020. Participants were encouraged to forward the survey to colleagues who met the same criteria. A reportable response rate was not available due to the survey distribution method.

Administered via Qualtrics, the survey consisted of 22 questions divided into three sections: personal information, research-related questions, and informed consent for Parts A and B. The survey included seven questions regarding personal details, 12 quantitative questions, and three qualitative questions. Appendix B contains a copy of the survey question.

In total, 55 surveys were conducted. However, 13 surveys needed to be completed, and more responses were needed, so they were excluded from the analysis. The remaining 42 participants completed data analysis. Participant demographics varied according to the school level, geographic location, and professional position. Part A of the study featured 42 educators, with approximately 29% working at the elementary level, 16% at the middle school level, 48% at the secondary level, and 5% working at the district level. A percentage (2.38%) of participants chose not to identify their educational level. The 42 educators mainly were spread between three states: Ohio

(88.10%), Missouri (4.76%) and Illinois (4.76%), respectively. A small percentage (2.38%) of respondents left their locations undefined. However, the participants confirmed working in urban areas during the 2018 – 2019 and 2022 – 2023 school years. The positions held by the participants included approximately 47% classroom teachers or aides, 17% administration, and 36% described as others, which included school counselors, community organizers, intervention specialists, and technology department members. Table 1 illustrates the percentage breakdown of participants based on these factors.

Table 1

Participant Statistics for Part A.

Statistics of Part A			
		Participants	
		Number	Percent
Totals		42	42
School Level			
	Elementary	12	28.57%
	Middle	7	16.67%
	Secondary	20	47.62%
	District	2	4.76%
	Undefined	1	2.38%
Demographics by State			
	OH	37	88.10%
	MO	2	4.76%
	IL	2	4.76%
	Undefined	1	2.38%
Position			
	Teacher	20	46.61%
	Admin	7	16.67%
	Other	15	35.71%

Table 1 shows the relevant data by school level, demographics, and position. The most common school level was secondary schools, at 47.62% (20) of the participants. The study parameters could have influenced this. The study requested teachers who teach STEM or STEM-adjacent subjects. An elementary-level educator typically teaches more than one subject; therefore, participants may have needed clarification on their eligibility. The high concentration of educators in Ohio (88.1%; 37 participants) may be attributed to the fact that the researcher was conducting their study in Ohio. With snowball sampling, the survey may have been passed on to other educators. It is also possible that teachers from the Ohio School District were more likely to participate in the study due to their familiarity with the university.

Furthermore, teachers from other states may not have been aware of the university or its research. When considering the participants' positions, the majority (46.61%, 20) were in standard teaching assignments. This may also have been affected by snowball sampling.

The survey questions were optional to answer to avoid discomfort. This lack of requirement led to the highest number of participants answering a single question (38). The number of responses by question and answer is shown in Table 2.

Table 2

Participant Statistics by Likert scale/choice question for Part A

Questions of Part A					
			# of Responses		
Question	Total # of Responses	Mean	Females	Males	Equally Split
How do you rate the STEM soft skills of students in the 2018-2019 year?	38	2.82			
How would you rate the STEM soft skills of students in the year 2022-2023?	38	2.69			
In the 2018-2019 school year, in your experience, were males or females more receptive to STEM lessons?	35		8	13	14
In the 2022-2023 school year, in your experience, were males or females more receptive to STEM lessons?	36		11	4	21
Please rate how commonly students show signs or speak of trauma during the 2018-2019 school years.	35	3.4			
Please rate how commonly students show signs or speak of trauma during the 2022-2023 school years.	35	4.14			
In the 2018-2019 school year, in your experience, were males or females more commonly observed showing signs of trauma?	33		4	11	18
In the 2022-2023 school year, in your experience, were males or females more commonly observed showing signs of trauma?	35		8	3	24
Please rate the perceived interest in pursuing a STEM degree or career change, if at all, during the 2018-2019 school year.	38	2.92			
Please rate the perceived interest in pursuing a STEM degree or career change, if at all, during the 2022-2023 school year.	38	3.21			

In the 2018-2019 school year, in your experience, were males or females more commonly showing interest in pursuing a STEM career?	32	5	14	13
In the 2022-2023 school year, in your experience, were males or females more commonly showing interest in pursuing a STEM career?	35	6	9	20

Table 2 averages the Likert-scale questions and provides the number of answers for the multiple-choice questions. Notably, the number of responses drops from 38 to 35 when the participant is asked to identify whether interest, trauma, or soft skill is more common in males or females. This may suggest discomfort or uncertainty regarding responses. The number of participants dropped when asked about trauma observation in students for similar reasons.

Along with Likert-scale and multiple-choice questions, the survey features three open-ended questions. These questions featured at the end of each topic: general STEM interest, observed signs of trauma, and student application of STEM soft skills. These open-ended questions allowed participants to add any comments they wished. The numbers of responses are listed in Table 3.

Table 3

Participant Statistics by open-ended Question for Part A.

Responses to Open Ended Questions of Part A	
Question	Total # of Responses
Please explain any additional information regarding change in students and their application of STEM soft skills between 2018-2023.	21
If applicable, please provide details of changes in observed signs of trauma.	17
If applicable, please provide details about perceived changes in STEM careers.	9

Table 3 shows the number of responses to the open-ended questions. The most notable feature was the stark decrease in the ones as the survey continued. This may have a similar issue as the Likert-scale or multiple-choice questions with participants decreasing comfort levels. This could also have been a lack of willingness to provide contextual answers by the time the participant worked through the survey.

Part A participants were most likely secondary-level classroom teachers based in Ohio. On a Likert scale, 35 and 38 of the 42 participants answered the questions. Of the 42 participants, 32–36 answered multiple-choice questions. While these questions had a smaller range of numbers, the open-ended questions ranged from nine responses to 21 responses from the 42 participants.

Study Part B: Interviews

Part B included educators who completed the survey and provided additional information through open-ended questions. The 17 educators who quoted were those who offered information beyond numerical ratings. Seventeen educators were asked to

participate in a follow-up interview. Ten of the 17 agreed to participate, resulting in a response rate of 58.82%.

The interview had 13 questions spanning four topics: STEM education and related soft skills, urban education, COVID-related mandated shutdowns, and the pandemic's effect on education. A copy of the interview questions can be found in Appendix C. Individual 45-minute interviews were conducted via Zoom at the participants' convenience. The interviews were analyzed using thematic coding.

The participants for Part B of the study showed an evenly distributed range between the academic levels they worked: 20% elementary level, 40% middle school level, 30% secondary, and 10% district level. All 10 participants were based in Ohio. The participants' positions within the school were as follows: 40% teachers or aides, 30% administration, and 30% identifying as others, including STEM specialists, technology directors, and invention specialists. These numbers are listed in Table 4. All participants in Part B answered all questions.

Table 4

Participant Statistics for Part B.

Statistics of Part B			
		Participants	
		Number	Percent
Totals		10	10
School Level			
	Elementary	2	20%
	Middle	4	40%
	Secondary	3	30%
	District	1	10%
	Undefined	0	0%

Demographics by State			
	OH	10	100%
	MO	0	0%
	IL	0	0%
	Undefined	0	0%
Position			
	Teacher	4	40%
	Admin	3	30%
	Other	3	30%

Table 4 shows the relevant data by school level, demographics, and participants' positions in Part B. Middle school was the most common school level (n = 4, 40%). The study parameters could have influenced this. The study requested teachers who taught STEM or STEM-adjacent subjects or administrators. The high concentration of educators in Ohio (100%, 10 participants) may be attributed to the researcher's location in Ohio. It is also possible that teachers from the Ohio School District were more likely to participate in the study due to their familiarity with the university. When considering the participants' positions, the majority (40%, 4) were in standard teaching assignments, while 30% (3) were administrators or were listed as others. Those identified as others included intervention specialists, technology coordinators, and academic coaches.

The profile participant in Part B is a middle-school-level teacher in Ohio. To avoid discomfort, participants were not required to answer all questions on the survey. However, all ten participants answered all questions.

Data Analysis

The research question findings are two-fold: Parts A and B. Part A consisted of an initial survey with Likert-scale, multiple-choice, and open-ended questions. The findings

for Part A within each research question were analyzed using means, comparison charts, one-sample t-tests, cross-tabulation, chi-square tests, and a six-step thematic coding process. Part B interviews were analyzed using six-step thematic coding, as defined by Terry et al. (2017).

Part A

The findings of Part A were analyzed using multiple types of tests based on the test of questions: the Likert scale questions used means and one-sample t-tests to compare numerical differences. The comparison charts analyzed multiple-choice questions to show the differences between the two years. The open-ended questions used the six steps of thematic coding defined by Terry et al. (2017) and are defined more in Part B.

Part B

Findings for Part B within the Research Questions were analyzed using thematic coding and emerging themes from participants' answers. The researcher used six steps of thematic coding, as set forth by Terry et al. in The SAGE Handbook of Qualitative Research in Psychology (2017). The six steps are as follows: familiarization with the data, generating code, constructing themes, reviewing themes, defining and naming themes, and producing the final report. The application of the steps in Part B of this study is detailed below.

The researcher became familiar with the provided data as the ten participants were interviewed individually. Interviews with recorded notes were also conducted. The researcher made sure to note that the phrases were repeated as the interviews continued. Once the interviews were completed, codes were generated using themes within the

interviews and consistently mentioned words and phrases. The four topics the interview questions were focused on were STEM education and related soft skills, urban education, the possible effects of the COVID-19 shutdown, and the pandemic's overall effect. While these were predetermined themes set by the researcher's questions, more apparent themes were identified in the participants' answers.

Inductive coding approach when coding data. Inductive coding was used with raw data while retaining bias (Terry et al., 2017). An inductive coding approach was used to identify recurring themes and themes that became clear in the data. A list of all the identified codes is presented in Table 5.

Table 5

Identified Codes from the Interview Data.

Codes	
Critical Thinking is hard	Impacted by COVID Restrictions
Work not being completed	Anxiety/Fear of failure
Student Work ethic dropped	Lowered Academic resiliency
Lack of socioemotional learning	Attention spans are limited
Attendance Issues	Trauma being apparent during lessons
Students were hesitant to work hands on	Anxiety/Fear of failure
Hands-on Engagement Positively Received	Cultural Barriers (Language, importance of education)
External Tools Aid Lessons	Behavioral Issues (non-violent)
Technology created opportunity in the classroom	Behavioral Issues (violent)
Poor brainstorming skills	Decline value of education
Lack of necessary support for staff and students for academic based interventions	Homelife interference
State Test scores suffered	

These groups were then used to create groups, which led to the third step of constructing themes. The data focused on the STEM key characteristics defined by Jolly (2014), which include real-world application, hands-on learning, use of the engineering design process, teamwork, and inquiry-based learning. Table 6 shows the potential themes based on the STEM characteristics.

Table 6

Codes with Potential Themes Based on STEM Characteristics.

STEM soft skills as defined by Jolly (2014)	Key Term used by educators
Real-World Applications	Critical Thinking is hard
	Work not being completed
	Student Work ethic dropped
	Lack of socioemotional learning
	Attendance Issues
Engaging in Hands-on Learning	Students were hesitant to work hands on
	Hands-on Engagement Positively Received
	External Tools Aid Lessons
Integration of Engineering Design Processes	Technology created opportunity in the classroom
	Poor brainstorming skills
	Lack of necessary support for staff and students for academic based interventions
	State Test score suffered
Teamwork	Impacted by COVID Restrictions
	Anxiety/Fear of failure
Inquiry Based Learning	Lowered Academic resilience
	Attention spans are limited
Additional Trauma-Related Findings	Trauma being apparent during lessons
	Anxiety/Fear of failure
	Cultural Barriers (Language, importance of education)
	Behavioral Issues (non-violent)
	Behavioral Issues (violent)
	Decline value of education
	Homelife interference

After all, data were reviewed and grouped into themes based on information from the literature review. Themes were reviewed to ensure that each theme was adequately related to data from the interview and aligned with the research questions. Table 7 shows the relationship between the ship and codes and themes of the research questions.

Table 7

Defining and Naming Themes

Thematic Category/STEM soft skills as defined by Jolly (2014)	Research Question
Real-World Applications Engaging in Hands-on Learning	RQ 1
Integration of Engineering Design Processes Teamwork Inquiry Based Learning	RQ 2
Trauma	RQ 3

Once sufficient support data was found, themes were defined and named. The six themes are real-world application (RQ 1), hands-on learning (RQ 1), Engineering Design Process (RQ 2), teamwork (RQ 2), inquiry-based learning (RQ 2), and Trauma (RQ 3). Lastly, producing the report using the themes is the last step that can be made. The information that was coded and applied to the themed research questions was written in the report. This production includes several frequencies in codes and quotes from individual

interviews. The data analysis findings are in the Findings sections under Part B for the three research questions.

Findings

Primary data from the study were analyzed to identify emerging themes using codes, categories, and themes. The findings are reported as findings based on the following research questions:

1. How do urban STEM educators rate and describe general student STEM interests from the pre-pandemic to the present?
2. How do urban STEM educators rate and describe student soft-skills development from the pre-pandemic to the present?
3. How do urban STEM educators rate and describe observed signs of trauma in students from the pre-pandemic to the present?

The following significant findings emerged from these phrases: From 2018 to 2022, educators in the study quantitatively rated increases in their students' STEM soft skills development, particularly in the areas of interest in STEM education and classroom applications of STEM soft skills. Jolly (2014) categorized soft skills as real-world applications, engaging in hands-on learning, integrating engineering design processes, teamwork, and inquiry-based learning. From 2018 to 2022, educators in the study qualitatively described students' interests in STEM and classroom applications of STEM soft skills as more evenly distributed between males and females, post-pandemic decreases in student work ethics, student difficulties in applying critical thinking skills in classroom lessons, and conflicting student interest levels in classroom technology usage.

Through a survey and participant interviews, data were collected regarding the rates and descriptions of educators of their urban students' STEM soft skills development. Key study findings centered on the students' soft skills development in interest, classroom applications, and observed signs of trauma. The following is an explanation of the key findings regarding the Research Question. This study aimed to answer three research questions and corresponding hypotheses. The population sample included 42 Midwestern urban educators. The results for each research question and their corresponding hypotheses are as follows:

RQ 1: Urban STEM educators' ratings and descriptions of students' general interest in STEM from pre-Pandemic to the present

The study participants were urban STEM educators from the Midwestern United States. 42 participants were asked to rate students' general interest in STEM education and classroom applications of STEM soft skills development between the 2018-2019 and 2022-2023 school years via a survey.

Hypothesis: After the pandemic, educators feel their students' STEM interests have increased.

Part A: Educators' Rated Students' General Interests in STEM Education (RQ 1)

The study's survey collected data showed that between 2018 and 2023, students' general interest in STEM education increased slightly from 2.92 and 3.22 (on a 5-point Likert Scale), with standard deviations of 0.91 (2018) and 0.90 (2022). This indicates a slight (3.0) rise in teachers' ratings of students' interest in STEM from 2018 to 2023. The data and calculations are listed in Table 8.

Table 8

Study Educators' Ratings of Students' STEM Interests and Classroom Applications of STEM Soft Skill

Statistics					
		STEM Interest 2018	STEM Interest 2022	STEM Applied Soft-Skills 2018	STEM Applied Soft-Skills 2022
N	Valid	42	42	42	42
	Missing	0	0	0	0
Mean		2.92	3.21	2.82	2.69
Std. Deviation		0.9	0.89	0.84	0.82
Variance		0.81	0.8	0.73	0.66

Table 8 shows the increase in students' general STEM interest. A one-sample t-test was used to examine any significance. The results are presented in Table 9.

Table 9

One-Sample Test Showing any Significance when Comparing Students' General STEM Interest from the 2018 to 209 School Year and the 2022 – 2023 School Year

One-Sample Test							
	Test Value = 0						
			Significance			95% Confidence Interval of the Difference	
	t	df	One-Sided p	Two-Sided p	Mean Difference	Lower	Upper
Please rate the perceived interest in pursuing a STEM degree or career change, if at all, during the 2018-2019 school year.	19.748	37	<.001	<.001	2.92105	2.6213	3.2208
Please rate the perceived interest in pursuing a STEM degree or career change, if at all, during the 2022-2023 school year.	21.864	37	<.001	<.001	3.21053	2.913	3.5081

Table 9 shows the possible significance signs when comparing the two years of schooling. The t-values for both school years are large (19.748 and 21.864, respectively), indicating that the observed mean perceived interest ratings significantly differ from the test value of 0. The p-values for one-sided and two-sided tests were less than 0.001, suggesting prominent significance levels. Therefore, we can conclude that the mean perceived interest ratings significantly differed during Part A of the study in both school years. A more detailed rating of the Likert-scale questions for RQ 1 is shown in Figure 2.

Figure 2

Line Graph Comparing the 2018 –2019 School Year and the 2022 – 2023 School Years' General STEM Interests

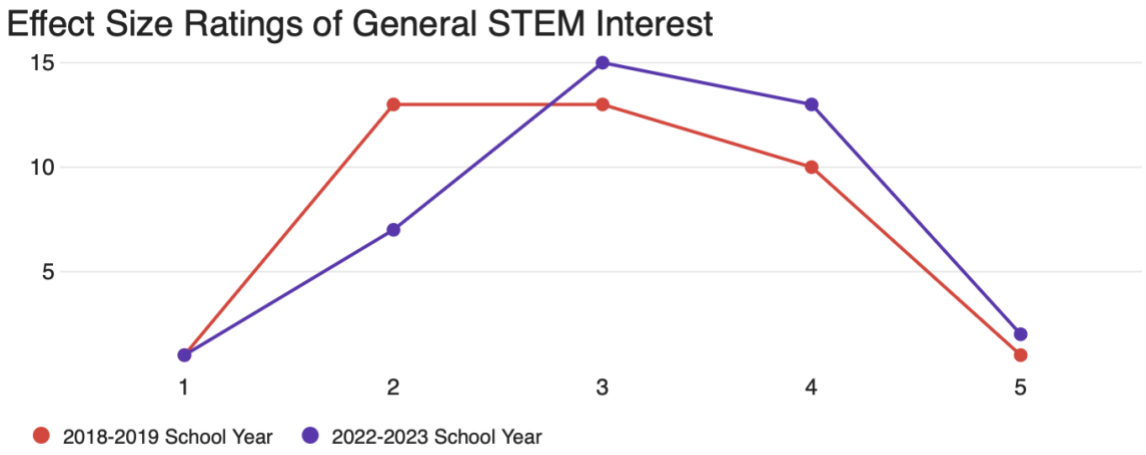


Table 5 shows all reported statistics regarding students' general interest in STEM education and changes in their classroom applications of STEM soft skills. Furthermore, this relationship could be cross-tabulated. Table 10 presents the study's results.

Table 10

Cross Tabulations of STEM General Interest between the 2018 and 2019 School Year and the 2022 – 2023 School Year.

Please rate the perceived interest in pursuing a STEM degree or career change, if at all, during the 2018-2019 school year. * Please rate the perceived interest in pursuing a STEM degree or career change, if at all, during the 2022-2023 school year. - Crosstabulation	
Count	
	Please rate how commonly students show signs or speak of

trauma during the 2022-2023 school years.

		1	2	3	4	5	Total
Please rate the perceived interest in pursuing a STEM degree or career change, if at all, during the 2018-2019 school year.	1	1	0	0	0	0	1
	2	0	3	6	4	0	13
	3	0	2	6	5	0	13
	4	0	2	2	4	2	10
	5	0	0	1	0	0	1
Total		1	7	15	13	2	38

Many of the responses fell into the three and four categories for both academic years, indicating a moderate to high perceived interest in pursuing a STEM degree or career change. There is a slight increase in the number of responses in the higher categories (4 and 5) in the 2022-2023 school year compared with the 2018-2019 school year, suggesting a potential increase in interest levels.

The open-ended question related to the perceived changes in students' STEM general interest asked participants to share any additional thoughts. Of the 42 participants, nine (21.43%) responded to the open-ended question. This may be due to a lack of observed student interest from educators or the possibility that the question was the last on the survey and that participants had already provided approximately 20 minutes of their time on the survey. Of the nine that responded, six coding steps (as described in the data analysis section) were used to identify themes of an increased number of students with future goals related to STEM and a general interest in the medical and health fields.

The themes of future goals in STEM and interest in medical fields may be vital to the increase of students using new innovative technology made readily available during the pandemic's shutdowns. Urban Educator 11 stated, "The increased exposure to STEM

makes more students interested." Urban Educator 3 reflected that since returning face-to-face, students have been excited when taking classes such as "medical detectives and engineering courses," which the educator said is accomplishing the goal "to bring STEM awareness" to more students. When considering gender, Urban Educator 15 mentioned that post-pandemic found "out of the STEM career fields, most of the students were females, but the males were very close behind in the gap." This educator also shared that most students are enrolled and succeeding in nursing and anatomy classes. Additionally, Urban Educator 5 mentioned an increase in students who aimed to become a doctor or STNA.

Part B: Educators' Describe Students' General Interests in STEM Education (RQ 1)

Commonly used phrases that the participants most discussed included: "Critical Thinking is hard," "Work not being completed," and "Student Work ethic dropped." "Lack of socioemotional learning," "Attendance Issues," "Students were hesitant to work for hands-on," "Hands-on Engagement Positively Received," and "External Tools Aid Lessons."

The above phrases were then coded into a group based on the five characteristics of STEM defined by Jolly (2014): real-world applications, hands-on learning, integration of the engineering design process, teamwork, and inquiry-based learning. This process was used for all Part B research and analysis of each research question to determine each phrase's category.

While real-world applications and hands-on learning support RQ 1, the other characteristics better support RQ 2 and are discussed later in this chapter. Real-world application uses application-style thinking to demonstrate a task while understanding

perseverance, diligence, and communication within a team. Hands-on learning practices logical and practical thinking skills while presenting an engaging challenge that prompts research and resiliency.

This finding suggests that students were more interested in STEM lessons in the 2022 – 2023 school year than before the pandemic. Students found safety in learning through exploring the pandemic through anatomy (real-world application) and a sense of normalcy when asked to work hands-on in the class.

Real-world Applications. Participants were encouraged to provide additional observations that provided insights into common themes, such as females having a higher interest in post-pandemic STEM. Urban Educator 1 noted the "more inclusion so that diverse students see themselves in materials and other resources." Additionally, educators shared perspectives such as a lack of work ethics and attention spans from students during STEM lessons. These were mentioned through open-ended questions from the initial survey and follow-up emails. Using real-world applications to aid students' learning includes skills such as crucial thinking, as seen in Figure 1.

Figure 1

Chart of Respondents' Commonly Used Phrases (an "X" is identified by the participant)

STEM soft skills as defined by Jolly (2014)	Key Term used by educators	Urban Educator 1	Urban Educator 2	Urban Educator 3	Urban Educator 4	Urban Educator 5	Urban Educator 6	Urban Educator 7	Urban Educator 8	Urban Educator 9	Urban Educator 10	Urban Educator 11	Urban Educator 12	Urban Educator 13	Urban Educator 14	Urban Educator 15	Urban Educator 16	Urban Educator 17	Total Number of Educators Mentioned each Key Term
Real-World Applications	Critical Thinking is hard	x	x		x			x	x			x		x			x		8
	Work not being completed	x		x		x		x		x			x						6
	Student Work ethic dropped	x		x	x				x		x	x	x	x			x	x	10
	Lack of socioemotional learing	x			x				x										3
	Attendence Issues	x	x			x		x	x	x			x	x	x		x	x	11
Engaging in Hands-on Learning	Students were hesitant to work hands on		x	x	x		x		x			x							6
	Hands-on Engagement Positively Recieved	x	x		x	x	x	x		x	x			x	x	x		x	12
	External Tools Aid Lessons	x	x		x	x					x								5
Integration of Engineering Design Processes	Technology created oppotunity in the classroom			x					x										2
	Poor brainstorming skills	x	x			x		x	x	x			x	x	x		x	x	11
	Lack of necessary support for staff and students for academic based interventions	x		x				x					x				x	x	6
	State Test score suffered		x	x	x				x	x		x							6
Teamwork	Impacted by COVID Restrictions		x		x													x	3
	Anxiety/Fear of failure		x	x	x		x	x		x				x					7
Inquiry Based Learning	Lowered Academic resiliency			x					x										2
	Attention spans are limited	x					x	x			x	x						x	6
Additional Trauma-Realted Findings	Trauma being apparent during lessons		x	x	x	x		x		x	x			x			x		9
	Axiety/Fear of failure		x	x	x		x	x		x				x					7
	Cultural Barriers (Langauge, importance of education)		x	x	x				x	x		x							6
	Behavioral Issues (non-violent)	x	x			x	x		x	x	x		x	x	x	x			11
	Behavioral Issues (violent)		x		x	x		x	x	x	x	x			x	x	x	x	12
	Decline value of education	x		x		x			x	x			x						6
	Homelife interference	x			x	x	x		x	x			x					x	8

As shown in Figure 1, multiple educators reported similar experiences with students. Those related to real-world applications include the difficulty of critical thinking for students (8 of 17 educators), incomplete work (6 educators), general lack of work ethics (10 educators), lack of socioeconomic learning (3 educators), and increased issues with attendance (11 educators).

Several quotes from the interviews stood out. When considering students' ability to think critically, Urban Educator 4 explained that they had to develop a system to reintroduce critical thinking skills and slowly let students practice them more each time. This educator expressed the importance of routines as "they seemed to provide some certainty during a time of constant uncertainty." The lack of completed work was discussed at differing levels. Urban Educator 11 expressed concern about the lack of

student learning during the pandemic years, causing issues in today's classroom. When looking deeper at students in urban schools who typically have trauma, Urban Education 9 recalled multiple times a student would not complete the answer because they did not have a crucial tool to access the work, such as a pencil or their password. These same students expressed a fear of asking for a resource for fear of being criticized negatively by their classmates for being unprepared. These experiences relate to the general unwillingness to do schoolwork and lack of a work ethic. The real-world application problems lead to a lack of discomfort as students realize their lack of understanding of the world around them. Urban Education 13 mentioned the difficulty of students missing entire academic units worth seeing.

Engaging in Hands-On Learning. Another key finding was the student difficulty observed when presented with critical thinking problems in the classroom, typically seen in STEM education as hands-on learning. While this was not widely mentioned as a real-world application, 12 17 educators mentioned the positive reception of hands-on lessons in classrooms. However, six educators noted hesitancy when students were presented with hands-on learning after returning to a post-pandemic classroom. Those two were the only negative outliers, while others reported having more positive reactions regarding students having had better academic success in classrooms with hands-on learning. Urban Educator 3 described multiple instances of students with a higher interest in technology after relying heavily on it during the pandemic. Six of the 17 participants mentioned increased interest in hands-on engagement. However, 12 respondents felt that students were more eager to complete the work if it was active and hands-on as opposed to more passive learning (textbook or lecture-style learning). Urban

Educator 14 stated that gaining interest is a struggle as students are disengaged from school.

Similarly, six of the 17 participants mentioned an overall lack of motivation to work unless activities were hands-on. Urban Educator 10 stated that the curriculum changed from learning facts and skills to learning survival and understanding during the pandemic, which diminished the academic goals of many students while being virtual. Despite curriculum changes, six participants still cited the constant interference of home life as an issue to keep students engaged properly. Urban Educator 14 described a level of entitlement upon returning to school, stating that students felt attendance alone should allow them to pass classes, and classwork was just a formality.

When further exploring the interviews to identify the three main coded phrases, "Students were hesitant to work hands-on," "Hands-on Engagement Positively Received," and "External Tools Aid Lessons," there were multiple quotes that stood out. Urban Educator 12 described an "almost eerie sense of fear, discomfort, and anxiety filling the room the moment I announced an activity that required some hands-on work." Urban Educator 14 retold a day when students asked to work in a virtual lab instead of doing a physical chemistry experiment. The educator continued to push students to work in the actual lab, and after some work, they agreed that if it became too much, students could turn to virtual labs. However, by the end of the class, all students had opted to do the hands-on lab and openly talked about enjoying it, asking to do more. Urban Educator 7 discussed reoccurring situations where students would completely shut down at the idea of working with tools other students used, even after cleaning the tools thoroughly. They continued, "These tools had to be soaked daily and only used once a week when they

used to be a tool used daily. Pictures and proof of cleaning were sent home to prove the cleaning process, and even then, some students claimed the pictures were faked." Urban Educator 3 talked about how students begged to use technology. This educator has found ways to work technology into different parts of the lesson, making the transition back to the classroom more manageable for students. The educator described using methods such as looking up the topic of discussion on social media to understand how the world views it.

The increases reported by study educators suggest a rise in students' general STEM interest in the classroom. STEM features new ways of teaching, such as real-world applications, hands-on learning, engineering design practice integration, student teamwork, and inquiry-based learning, and experiences new ways of learning and engaging with the curriculum (Jolly, 2014). A suggested connection between students' understanding of STEM lessons and these education methods is supported by this study's finding of a rise in student STEM interest.

RQ 2: From 2018 to 2022, Urban STEM educators' ratings and descriptions of student soft-skills development from pre-Pandemic to the present

Science, Technology, Engineering, and Mathematics (STEM)-focused education requires the application of multiple soft skills, including real-world applications, engaging in hands-on learning, integration of engineering design practices, teamwork, and inquiry-based learning (Jolly, 2014). RQ 2 consists of multiple majors, such as urban STEM educators describing students' soft skills development in the form of classroom applications of STEM soft skills as more evenly distributed between males and females, decreases in students' work ethics, post-pandemic, student difficulties in applying critical

thinking skills in lessons, and conflicting student interest levels in classroom technology usage.

Hypothesis: After the pandemic, educators sense that their students' soft skills have declined compared with before the pandemic.

Part A: Urban STEM Educators' Rated of Changes in Students' Classroom Applications of STEM Soft-Skills (RQ 2)

Soft skills are those learned through experience that might not be taught in the same way as the core subjects. During the 2018 – 2019 school year, educators reported on a Likert scale (0 to 5) that students were applying STEM soft skills in the classroom STEM soft skills with 0 meaning no interest at all and five meaning highly interested, at a 2.82, with a standard deviation of 0.84. When asked to consider the same interests in the 2022-2023 school year, educators reported 2.69, with a standard deviation of 0.82. These ratings (see Table 8) show a slight change in educators' ratings of STEM students' classroom application for soft skills between 2018 and 2023. The educator ratings and effect sizes are shown in Figure 3.

Figure 3

Comparison Line Graph of Educators' Ratings of Students' Development and Application of STEM Soft Skills From the 2018-2019 School Year to the 2022-2023 School Year

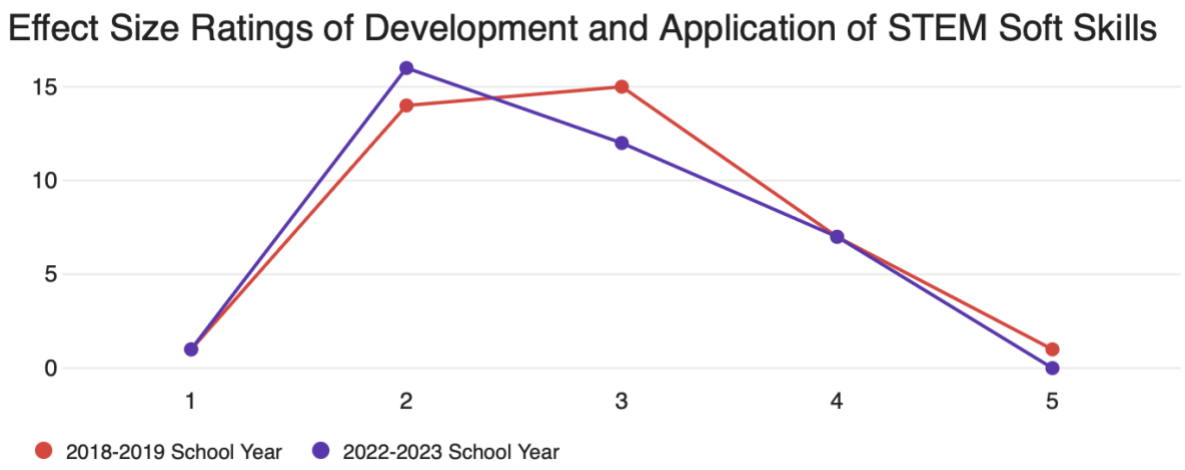


Figure 3 shows a slight shift in the post-pandemic school years. A one-sample t-test was used to account for any possible significance. These findings can be seen in Table 11

Table 11

One-Sample Test Showing any Possible Significance when Comparing Student STEM Skills Applications from the 2018 to 209 School Year and the 2022 – 2023 School Year

One-Sample Test							
	Test Value = 0						
			Significance			95% Confidence Interval of the Difference	
	t	df	One-Sided p	Two-Sided p	Mean Difference	Lower	Upper
How would you rate the STEM soft skills of students in the 2018-2019 year?	20.057	37	<.001	<.001	2.81579	2.5313	3.1002
How would you rate the STEM soft skills of students in the 2022-2023 year?	19.672	35	<.001	<.001	2.69444	2.4164	2.9725

Table 11 shows multiple signs of significance when comparing two years of schooling. The t-values for both school years are large (20.057 and 19.672), suggesting that the observed STEM soft skills rating significantly differs from the test value 0. The p-values for the one- and two-sided tests were less than 0.001, which is highly significant. This implies that the probability of observing such extreme results is exceptionally low. Therefore, this suggests that the mean STEM soft skills ratings during Part A of the study significantly differ from 0 in both school years. A more in-depth breakdown of the Likert-scale ratings is presented in Table 12.

Table 12

Cross-tabulations of student STEM soft skills between the 2018 and 2019 school year and the 2022 – 2023 school year.

How would you rate the STEM soft skills of students in the 2018-2019 year? * How would you rate the STEM soft skills of students in the 2022-2023 year? Crosstabulation

Count

		How would you rate the STEM soft skills of students in the 2022-2023 year?				
		1	2	3	4	Total
How would you rate the STEM soft skills of students in the 2018-2019 year?	1	1	0	0	0	1
	2	0	6	5	1	12
	3	0	6	5	4	15
	4	0	3	2	2	7
	5	0	1	0	0	1
Total		1	16	12	7	36

The cross-tabulation compares the ratings of STEM soft skills of students in the 2018-2019 year with those in the 2022-2023 year. Many of the ratings fall in the 2.00 and 3.00 categories for both academic years, suggesting that the STEM soft skills of students were mostly rated as average or above average. There is a slight shift towards higher ratings in 2022-2023 compared to 2018-2019. For example, in 2018-2019, 12 students were rated 2.00, while in 2022-2023, 16 students were rated 2.00. The number of students rated 4.00 increased from 2 in 2018-2019 to 7 in 2022-2023, indicating a potential improvement in STEM soft skills.

STEM educators in their classrooms gauged the responsiveness of learning through students' success in tasks and the growth of students' soft skills. As students

returned to the classroom post-Covid, participants reported decreases in soft skills developed by applying to student applications in classrooms. This finding suggests that, although students were more engaged in STEM lessons than before the pandemic, the skills required for STEM lessons to be successful were performed by students at lower levels than before the pandemic.

The participants were offered an open-ended question relating to the students' observations of STEM soft skills in classes to share any additional thoughts on the topic. Of the 42 participants, 21 (50%) responded to an open-ended question. This may be due to a lack of observed student soft skills in practice or a lack of time in physical classrooms to allow STEM soft skills to be practiced. Of the 21 responses, the six coding steps (as described in the data analysis section) were used to identify themes of general student reluctance, increased exposure to STEM within the curriculum, and shift to more female interest in STEM fields.

Educators spoke of student reluctance towards STEM, with Urban Educator 16 stating, “As we transitioned back to in-person learning, they (the students) are gradually beginning to participate more and more, but their skill sets were severely affected for those two years without participating in hands-on lab activities.” Urban Educator 4 shared:

> My classes from 2022-2023 just did not put in any effort. They had a hard time processing or completing any work independently (this class world ended their kindergarten year yearly and did first grade completely virtual, which significantly impacted them).

Urban Educator 8 mentioned that “many students now have less stamina and problem-solving strategies when encountering difficulty than students in 2018.” Urban Educator 7 shared a hope of a quick return to normalcy due to the observation of “females I found were more receptive to getting back to the normality of actively engaging in the learning process. The boys were not too far behind.”

Some educators noted an increase in STEM as a part of standard classes rather than clubs (as stated by Urban Educator 12). Urban Educator 10 stated, "There is more emphasis on STM education now than five years ago." This increased amount of STEM may be related to the observation shared by Urban Educator 1 that “the expansion of types of devices used about STEM; to 3D printing, tables, and laptops from using mobile devices” to complete schoolwork could really have an impact on interest simply by proximity.

Part B: Educators’ Described Changes in Students’ STEM Soft-Skills Development

Described Changes in Students’ STEM Soft-Skill Applications

When asked to describe the observed students’ application of STEM soft skills development, multiple educators across the Midwest noted increased emphasis by teachers on STEM skills, from pre- to post-pandemic, abilities to apply STEM soft skills. Educators in the study subjectively described these developments as students’ increased exposure to virtual learning and the growing accessibility of technologies in classrooms. The most commonly repeated phrases included: technology created opportunity in the classroom; poor brainstorming skills; lack of necessary support for staff and students for academic-based interventions; state test score suffered; impacted by COVID restrictions; anxiety/fear of failure; lowered academic resilience; and Attention spans are limited.

These then are split into the last three STEM characteristics. The characteristics often mentioned regarding STEM soft skills include using the engineering design process, teamwork, and inquiry-based learning. While real-world applications and hands-on learning support RQ 1, the other characteristics better support RQ 2. The engineering design process aims to improve pre-existing ideas, such as how technology is used in the classroom, how to create new ideas, finding new methods of classroom staffing, and test-taking skills. Using teamwork requires COVID restrictions, and a general fear of failure impacted communication and idea sharing. Inquiry-based learning allows students to have control over their education. Still, in the post-pandemic academic realm, students were reported to have lowered academic resiliency and limited attention spans that stifled the inquiry process.

Integration of Engineering Design Practices. Urban Educator 6 pointed out an increased number of students who would like to become doctors and engineers but needed help to grasp basic scientific notions. Urban Educator 2 explained that students were offered traditional courses such as math, history, science, and English and a "tech" path covering core subjects through career training. Most of these secondary students selected a healthcare path and achieved remarkable success. Conversely, Urban Educator 11, a teacher, noted that her students are considered low socioeconomic status and do not have the self-confidence to consider jobs requiring training or college degrees. Urban Educator 9 said that their students were overwhelmed by the demands of daily living without an opportunity to consider post-secondary choices.

Urban Educators 2, 4, 5, 7, 12, 16, and 17 mentioned a common theme of the need for more understanding of persistence towards technology. Urban Educator 17 shared that

students need to gain a basic knowledge of technology besides performing basic searches on websites such as Google. As the engineering design process is the third component of the key characteristics of STEM, the increased use of technology provided more opportunities for students to explore novel resources, as stated by the seven educators. A similar number of educators reported different skills related to their ability to use self-driven inquiry or a need for these skills. The skills mentioned included poor brainstorming skills (two of 17 educators), the necessary use of internal aides to adapt to distinct levels of learners (five of 17 educators), and a concern for a state test score suffering (four of 17 educators).

When looking at these coded phrases in more depth, educators shared their experiences in detail. When reflecting on technology as a means of education during and post-pandemic, Urban Educator 2 was excited about technology's newfound interest and proficiency, especially in young students, as they could use more resources in the classroom. This educator also stated they believed their students had a new level of understanding by adding a layer of reproduction to encourage the learning more completely. When considering brainstorming skills, Urban Educator 5 discussed students needing “much more handholding to begin any new ideas than before the shutdowns.” The educator shared an experience with a student who dropped the class, which was an introductory class for a career pathway course, after feeling unable to think of an original idea during a practice brainstorming example. Urban Educator 5 explained that the concept was unnecessary at this point as it was an example of a step later in the instructions, along with offering one-on-one help. The student denied the help, left the room, and dropped the class- changing their career pathway completely. Perhaps the

student would have reacted differently with an additional educator in the room. However, "finding support staff to aid the novel needs of students is next to impossible," stated Urban Educator 9. This educator said their school has posted job openings for aides with sign-on bonuses, high wages, and benefits for over a year. Urban Educator 15 found concern in the test scores after experiencing a shift in the ability to sit still in the class for more than 30 minutes. This educator said they often had to send wandering students back to class after the students "came to chat because they were bored."

Teamwork. Teamwork is a skill in which students must practice their career skills. Urban Educator 4 shared that providing a safe place to properly conduct STEM lessons while adhering to COVID-19 safety precautions is a continuous struggle, suggesting a correlation between the two. Three of the 17 interviewed participants also referred to some elements of their classroom and/or lessons being negatively impacted by COVID restrictions, such as always staying six feet apart from other students. These restrictions would prove problematic when students must collaborate on classroom projects. Seven of the 17 participants expressed fear and anxiety as constant factors in the classroom, which held students back from attempting work that seemed slightly challenging.

The experiences shared with COVID-19 were resounding. Urban Educators 2, 4, and 17 all used the word "isolated" to describe how students felt as their desks were either 6 feet apart and/or surrounded by plexiglass. Urban Educator 17 shared that one student called their plexiglass divider their "safety shield" and decorated it like a superhero's shield. The class was inspired, and each student decorated their dividers, which the educator said, "brought a sense of normalcy to a fragmented classroom."

Urban Educator 7 spoke of a project assigned to students, asking them to interview each other about how technology has impacted their lives and then share the collected information in a podcast-style video. “Out of 18 students, seven choose to take a zero rather than have to work in partners, " the educator added that they had never seen students shy away from a “fun” project. The educator spoke with a few of the seven students, who all stated it is unsafe to work with partners, even with safeguards in place.

Inquiry-Based Learning. Skills learned through teamwork are critical life skills, as are students learning through their interests or inquiry-based learning. Eight urban educators shared concern regarding the last attention span, as most students post-pandemic, with Urban Educator 8 expressing an observed lack of academic resilience and basic skills to persevere in challenging lessons. Urban Educator 3 spoke about a time when a student was trying to draw a blueprint that needed a circle. The student drew the circle multiple times, even tracing some items. After about four tries, the students felt they could not “draw the dumb blueprint,” and since they “cannot draw a stupid circle, they cannot do the whole assignment because it will all be just dumb and ruined.” Even with encouragement from the educator, the student would not even consider working on a blueprint with an already drawn circle.

Inquiry-based lessons require students to drive lessons based on their interest in learning. Urban Educator 1 stated, “After COVID, students did not have the focus needed for STEM lessons,” while Urban Educator 10 stated, “I noticed that many students now have less stamina and problem-solving strategies when encountering difficulty than students in 2018.” Urban Educator 6 described a class that “was going perfect with great engagement for about half the class until one student stood up declaring the class was

useless," and they were done learning it. After a quick walk to the water fountain, the student re-entered the room, took their student, and sat politely for the remainder of the class. While this student engaged early in class, they did not engage after their return. When the educator asked why they no longer wanted to participate, especially when they had been doing so well, the student replied, "I did not have the energy for that anymore." The educator was glad to hear the truth but said they consider it while planning lessons and their lengths.

RQ 3: Urban STEM educators' ratings of observed signs of trauma in students from pre-pandemic to the present

Hypothesis: Educators observe more signs of trauma in their students after the pandemic than before the pandemic.

Part A: Educators' Ratings of Changes in Signs of Trauma in Students

Trauma in classrooms can take many shapes and forms (Learning Hindrances of Stress & Trauma, 2019). The collected data asked educators to rate the signs of trauma observed in the classroom during the 2018–2019 and 2022–2023 school years. Midwestern educators reported on a Likert scale of 1-5, with 1 representing no signs of trauma and 5 representing extreme signs. STEM educators rated signs of trauma in students at 3.38 during the 2018-2019 school year. A one-sample t-test was used to examine any significance. The results are presented in Table 13.

Table 13

One-Sample Test Showed Significance when the Educator Observed Signs of Trauma within Classrooms from 2018 to 209 and the 2022 – 2023 School Year

One-Sample Test

	Test Value = 0						
			Significance			95% Confidence Interval of the Difference	
	t	df	One-Sided p	Two-Sided p	Mean Difference	Lower	Upper
Please rate how commonly students show signs or speak of trauma during the 2018-2019 school years.	19.997	34	<.001	<.001	3.4	3.0545	3.7455
Please rate how commonly students show signs or speak of trauma during the 2022-2023 school years.	35.414	34	<.001	<.001	4.14286	3.9051	4.3806

Table 13 shows that the t-values for both school years were large (19.997 and 35.414), suggesting that the observed mean ratings of students showing signs of or speaking of trauma significantly differed from the test value of 0. The p-values for one-sided and two-sided tests were less than 0.001, indicating prominent significance levels. Therefore, it is suggested that the mean frequency ratings are significantly different from zero for both school years.

Comparatively, in 2023, educators reported 4.15 signs of trauma in students. STEM educators rated the changes in signs of trauma in students with standard deviations

of 1.00 (2018) and 0.69 (2022). A cross-tabulation of these numbers is presented in Table 14.

Table 14

Cross Tabulations of STEM General Interest Between the 2018 and 2019 School Year and the 2022 – 2023 School Year

Please rate how commonly students show signs or speak of trauma during the 2018-2019 school years. * Please rate how commonly students show signs or speak of trauma during the 2022-2023 school years. Crosstabulation

Count

		Please rate how commonly students show signs or speak of trauma during the 2022-2023 school years.			
		3	4	5	Total
Please rate how commonly students show signs or speak of trauma during the 2018-2019 school years.	1	1	0	0	1
	2	1	2	2	5
	3	2	7	3	12
	4	2	7	2	11
	5	0	1	4	5
Total	6	17	11	34	

Many of the responses fell into the three and four categories for both academic years, indicating that the students commonly showed signs or spoke of trauma. There is a slight increase in the number of responses in the higher categories (4 and 5) in the 2022-

2023 school year compared with the 2018-2019 school year, suggesting a potential increase in trauma levels. The total number of responses was small (34).

The participants were offered an observed trauma-related open-ended question to share any additional related thoughts. Of the 42 participants, 17 (40.48%) responded to the open-ended questions. This may be due to a lack of observed student trauma in the classroom, a lack of knowledge of revolving trauma signs, or a level of discomfort when answering the question. Of the 17 that responded, the six steps of coding (as described in the data analysis section) were used to identify themes of acts of depression/self-harm or depreciation and a lack of social-emotional learning and associated repercussions.

Urban Educator 5 shared, "(an) intensity and frequency have increased since the pandemic for suicidal ideation, depression, and anxiety." Urban Educator 7 reported "anger and depression," while Urban Educator 11 reported an "increased (amount of) emotional burst and lack of self-control." Urban Educator 14 theorized that the general "inability to socialize appropriately since COVID-19" is a large part of the cause of this. Urban Educator 14 also mentioned that students openly discussed having contemplated suicide while in class. The educator continues to say, "Many students looked to street drugs and alcohol as a way to deal with the stress they were going through."

Part B: Educators' Described Changes in Signs of Trauma

While RQ 1 and RQ 2 focused on the five characteristics of STEM defined by Jilly (2014), RQ 3 was analyzed with coding. This coding was thematic and looked for frequently used words or phrases used by the educators. These phrases were coded into a group, apart from STEM-related phrases. This group is constantly affected by trauma. There were two major themes in the interviews in which participants openly discussed

their perception of student signs of trauma defined by depression, behavioral issues, illegal use of recreational drugs and/or underage drinking, and preconceived notions regarding education.

When asked to describe the signs of trauma in classrooms, educators reported three main types of behavior. The first of the three signs showed signs of depression or extreme stress. The American Psychology Association states that some symptoms are losing interest in favorite activities, prolonging feelings of worthlessness, or thoughts of suicide (2023). Urban Educator 2 recalled "witnessing more signs of depression and anger– even some openly discussing suicide." Urban Educator 7 also noted increased levels of anger and depression in classes, with more classroom outbursts among students who showed these signs. The second category of reported signs of trauma is an incredible behavioral issue. Urban Educator 15 discussed the severity of the increased troublesome behavior in schools. Some of these behaviors included bringing weapons to school, starting fights with insignificant reasoning, and even bullying students to get a reaction from them. Urban Educator 12 cited "a sharp rise in intense behaviors such as fighting that is disruptive in learning environments." This sign of trauma was reported by nine of the participants as a stark rise in violence and fighting between students. The last sign of trauma is increased use of street drugs and underage drinking. Urban Educator 8 discussed the rise in students openly discussing illegal drug and alcohol use and using these substances while in school. Urban Educator 16 stated that upon receiving devices such as laptops and tablets from students, it is expected to find students researching drugs and alcohol.

The educators described these three signs of trauma in detail. When asked about trauma in students, most participants reported that these signs were already present in the 2018 – 2019 school year but significantly increased in the 2022 – 2023 school year. Some of the most notable of these signs include idealization and openly speaking about suicidal thoughts, open refusal to work through any challenge, and an increase in students openly experiencing panic attacks, as described by Urban Educator 3. The 2022 – 2023 school year presented more challenges than most urban teachers had faced. These issues stem from student mental health, as noted by Urban Educator 4. Urban Educator 3 noted that the level of mental health issues students face today is above the capabilities of teachers in the classroom.

However, students found a safe place for education. Of the ten participants interviewed, eight participants stated that they believed that students felt safe in school and were eager to share their experiences, whether trauma-related or not, with different staff members within the school. Seven participants cited that most of the discussions with students were related to anxiety or fear of failure. While these signs of trauma were openly discussed, other signs were presented through actions rather than words. Urban Educator 15 theorized that poor attendance is not a student's fault but a family's underappreciation for education. Urban Educators 10, 14, and 15 shared that students and their families saw education as frivolous.

Multiple participants (Urban Educators 4, 6, 9, 10, 14, 16, and 17) theorized that an observed lack of socioemotional skills may contribute to the rise in signs of trauma. Urban Educator 14 suggested these underdeveloped skills may be related to the pandemic shutdown, as students were less likely to interact socially during this time. Urban

Educator 4 noted that students are so uncomfortable with social skills that they almost mimic a fight or flight reaction at insignificant things, such as believing another student looked at them "weird."

The participants noted these reactions. This rise in behavioral issues, both non-violent and violent, was mentioned during the study by all but one participant. Urban Educator 4 described a situation where, in one day, the educator received over 20 behavior reports in each of the middle school grades as an administration member. Urban Educator 15 described a much more extreme situation. In a matter of one school week, their secondary school experienced twelve fights inside the school, resulting in three students being in the hospital. While Urban Educator 3 did not explicitly cite behavior as an issue, the educator discussed the need for a new method of classroom management at the elementary level to adjust to new challenges post-pandemic.

When referring to Figure 1 and the common phrases that educators use, a substantial portion is related to trauma. Of the 17 urban educators who responded to the open-ended questions on the survey or in the interview, these were the most commonly used phrases: trauma is apparent during lessons (9 educators), cultural barriers such as language and/or importance of education (6 educators), non-violent behavioral issues (11 educators), violent behavioral issues (12 educators), a general cultural decline value of education (six educators), lowered academic resilience (two educators), and a level of life interference (eight educators).

Urban Educators shared their observations of trauma in the classroom, each sharing how much the trauma signs have grown in today's classroom. When discussing apparent trauma, Urban Educator 6 shared their dread of transitional time during the

school day "since just one wrong look could set off an atomic bomb in the school. Urban Educator 2 recalled a "spike in language barriers in the class after returning to the classroom." The educator theorized "more students were home, emerged with their entire families, allowing culture to blossom. While it is beautiful that these students got this time and learned of their culture, it has made it much more difficult to reach their kids whom we cannot communicate with." Non-violent behaviors were spoken of by 11 educators, with Urban Educator 9 discussing "the constant name calling and bullying that seems only to be exacerbated by social media and phones in classrooms." Violence crimes were spoken of by 12 educators, described by Urban Educator 14 was clear how their classroom "felt as if a breeze could start a fight." The educator said students were afraid of getting COVID, using it as a reason not to use materials to complete work but would throw a fist at another student without hesitation. Urban Educator 12 shared a fear of the devaluation of education as students often stated they do not care about their grades, and some parents will block the school's number not to receive calls when the student is struggling academically. Eight Urban Educators showed concerns about homelife interference while at school at an alarming rate. Urban Educator 3 recalled a student who was pulled from school daily to watch younger siblings, cousins, and any family member to help their mom out. The "student was permanently lost, and while they wanted to have straight support for their dream of becoming a doctor, the dream became increasingly unrealistic.

Emergent Finding: Gender Shifts in STEM and Trauma

An emergent finding became apparent as educators shared details about their classroom observations of shifts in gender-based interest, STEM soft skills, and trauma in

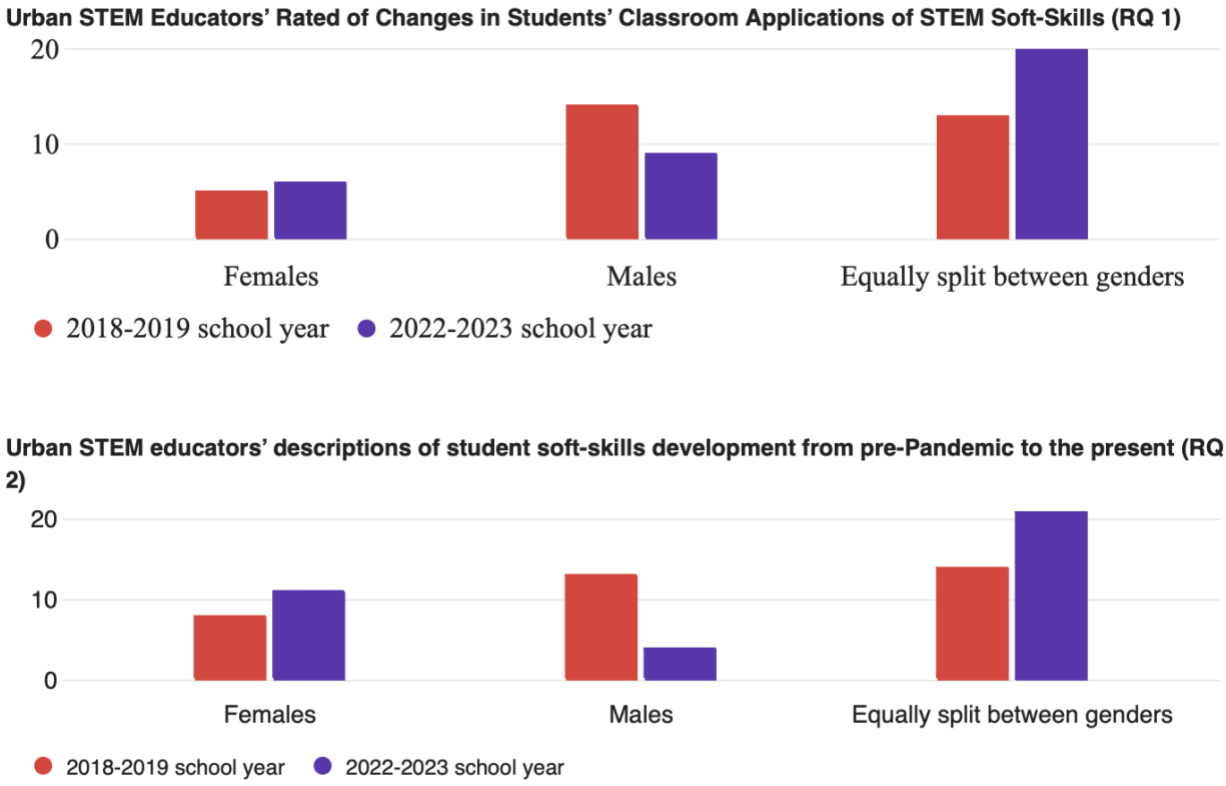
the classroom. Each research question contained Part A, primarily quantitative data based on multiple-choice questions and some qualitative data from open-ended questions. Part B found qualitative data from virtual interviews.

Research Question 1

Research question 1 focuses on the general student interest in STEM lessons within the classroom and/or any interest in pursuing a career in a STEM-related field. In 2018, 32 total educators answered the question regarding STEM interest, with five educators stating females favored STEM, and 14 educators stating males favored STEM, while 13 of the educators said it was an equal split between genders that showed an interest in STEM. In 2023, 35 total educators answered the questions regarding STEM interests. According to six educators, females were most likely to favor STEM. According to nine educators, males tended to favor STEM more, while 20 educators reported an equal split between males and females interested in STEM. The data in Table 8 also indicate that in 2018, more males were interested in STEM education. In 2023, educators reported equal interest between males and females, as shown in Figure 4.

Figure 4

Comparison Bar Graph Comparing Educators' Ratings of Students' General Interests in STEM Education and Application of STEM Soft Skills from the 2018-2019 School Year to the 2022-2023 School Year



This bar graph shows the number of females and males with general STEM interests (RQ 1) and the application of STEM soft skills (RQ 2). In case male or female students did not favor the desired information, an option labeled "Equal Between Genders" was provided for participants.

Part B of this study collected qualitative data. When asked about gender shifts in STEM interest, Urban Educator 6 stated, "I noticed a lot more female students are eager to collaborate and lead in STEM challenges and lessons now compared to 2018.". Urban Educator 11 stated, "I had very few female students involved in my STEM program early on. Although STEM has been a male-dominated field in my school, I have seen a sharp

increase in the number of female students involved in STEM, and I think it is a matter of time before enrollment is equally split."

Research Question 2

Research question two looked at the application and development of STEM soft skills. Part A of the study found quantitative data regarding gender with STEM soft skill development and application in classrooms. In 2018, 35 total educators answered the question regarding STEM soft skills application while participating in class, with eight educators stating females strongly use soft skills, 13 educators stating males strongly use soft skills in class, and 14 educators said it was an equal split between genders that used STEM soft skills in class. In 2023, 36 educators answered STEM soft skill development and classroom application questions. Females were most likely to apply STEM soft skills, according to 11 educators; males tended to apply soft skills in class more, according to four educators, while 21 educators reported an equal split between males and females who were using STEM soft skills in classroom lessons.

Part B of the study looked at qualitative data, which found educators discussing changes in STEM soft skills between genders in classes. The increase in female interest was mentioned, and several theorized reasons were given. Urban Educator 6 mentioned a rise in female enrollment in STEM electives and doing well in the courses. At the same time, Urban Educator 3 noted more inclusionary practices within STEM materials "so that diverse students, including females, see themselves"'. Urban Educator 17 noticed females' interest in understanding the pandemic and how it relates to human anatomy and physiology, implying an interest in applying science to a real-world problem.

Research Question 3

Part A of the study collected qualitative data regarding signs of trauma. When examining collected information from research question 3 regarding trauma, 33 total educators reported their observed signs of trauma. Four of the 33 educators reported more signs of trauma seen in females, while 11 educators reported more males showing signs of trauma. Of the 33 educators, 18 reported observed signs of trauma were seen in both males and females. In 2023, 35 total educators reported signs in their classrooms. Eight educators stated females showed more signs of trauma, while three educators reported males showing more trauma-related behaviors. Of the total 35 educators who responded, 24 of the educators stated that the signs of trauma observed in the classroom came from both males and females. This is illustrated in Figure 5.

Figure 5

Comparison Bar Graph Comparing Educators' Ratings Observed Signs of Trauma in the Classroom from the 2018-2019 School Year to the 2022-2023 School Year

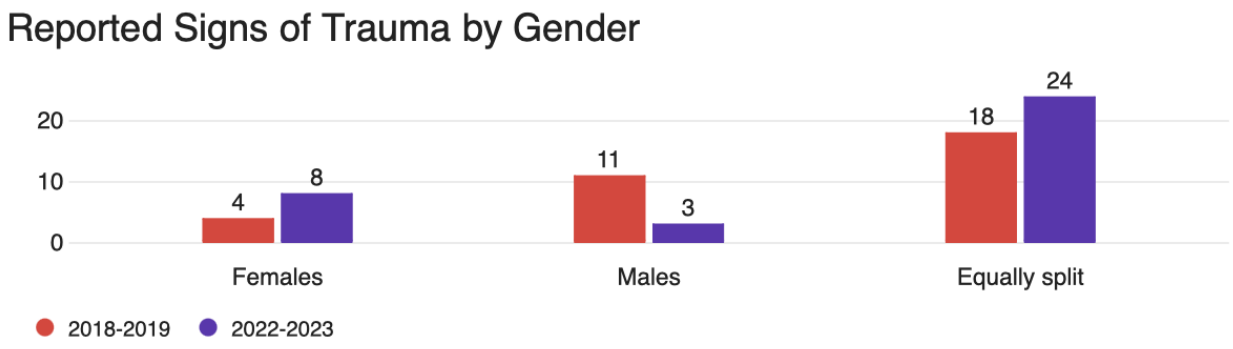


Figure 4 depicts the increase in female observed signs of trauma between the two school years and a decrease in males. However, it is notable that the number of males and females (equally split) also increased.

Part B of the study looks at subjective, qualitative data regarding trauma. Ten educators were interviewed and shared their observations of trauma in classrooms. Urban

Education 14 stated that “the females were more likely to share their feelings, but with the males, they keep that information to themselves until prompted.” Urban Educator 2 stated, “Females seem to talk more openly than males; I don’t know why.” However, Urban Educator 13 stated, “much more anxiety, both generalized and school-specific, in students now compared to students in 2018. "Across all genders.” Urban Educator 7 stated, “a lot of males exhibited this in the form of violence” and “it was shown more in females but in the form of not getting along with each other and being very harsh to one another.” Urban Educator 6 expressed “students discussing trauma and adverse experience has increased in recent years. I am not sure whether this is due to an increase in trauma/adverse experiences or an increase in students’ comfort levels when discussing those topics.”

Summary

This mixed-methods study assessed Midwestern urban educators' ratings and descriptions of students' STEM interest and soft skill development and observed signs of trauma from the pre-pandemic (2018-2019) to 2022-2023. The study employed surveys with a Likert scale, open-ended questions, and follow-up interviews.

Nonprobability sampling was used to select 42 urban Midwestern STEM educators who worked before and during the pandemic. Most of the participants were from the Ohio (88%), elementary (29%), middle (16%), and secondary (48%) levels. 47% were teachers or aides. Ten participants were selected for the follow-up interviews.

In research question 1, it was found that from 2018 to 2022, educators rated slight increases in students' STEM interest (2.92 to 3.22 mean). Educators described an increased number of students with future goals related to STEM and general interest in

the medical and health fields. Educators also reported a decrease in students' soft skill application, with a mean in 2018 of 2.82 and a mean of 2.69 in 2023. While numerically, the standard deviation is slight, educators reported general student reluctance, increased exposure to STEM within the curriculum, and a shift to more female interest in STEM fields.

Trauma signs in students have increased from 3.38 in 2018 to 4.15 in 2022. Educators reported that different genders show signs of trauma, such as acts of depression/self-harm or depreciation and a lack of social-emotional learning and associated repercussions. Educators reported increased depression, anger, suicidal thoughts, behavioral issues, fighting, and substance use among students after the pandemic.

An emergent finding showed a general gender shift in all three research questions. In research question 1, general STEM interest became more evenly split between males and females than the 2018 level that favored males. In research question 2, the application of STEM soft skills,

The study found slight post-pandemic increases in STEM interest and soft skills but also significantly higher rates of trauma signs among urban Midwest students, according to educator ratings and descriptions. Gender differences in STEM interest and trauma also shifted from traditionally favoring females with signs of trauma to either more males showing signs of trauma or an equal number of trauma signs of both genders.

Chapter V

Discussion

This study employed a mixed-method approach to investigate Midwestern urban educators' perceptions of changes in students' general STEM interests and soft skill development. The researchers observed signs of trauma in the classroom from the pre-pandemic 2018-2019 school year to the 2022-2023 school year. They used a case study methodology to gather quantitative and qualitative data.

Quantitative data were collected through a survey administered to 42 STEM or STEM-related educators or administrators, which included Likert-scale and multiple-choice questions. Qualitative data were obtained through open-ended questions in the survey and further supplemented by ten follow-up interviews, providing more in-depth insights. This study aimed to answer the following research question:

1. How do urban STEM educators rate and describe general student STEM interests from the pre-pandemic to the present?
2. How do urban STEM educators assess and characterize students' soft skills development before and after the pandemic?
3. How do urban STEM educators evaluate and depict the observed signs of trauma in students before and after the pandemic?

The COVID-19 pandemic is being referred to as a mass traumatic event that causes many long-term issues (Kaubiscch et al., 2022). In February 2021, 42% of school districts in the United States returned to classrooms in rural communities, 27% returned within suburban communities, and a significantly lower 17% returned within urban communities (Schwartz et al., 2021). This sharp decrease in urban students' back in

school meant they were not receiving the necessary education. With such a small number of urban districts, the long-term effect on students' abilities is long-term. Before the pandemic began, there was a push for STEM education that taught skills not easily taught in classrooms (Jolly, n.d.). It is unknown how these skills will continue translating into a full-term brick-and-mortar education.

Each of these factors contributed to the necessity of this study. This chapter will review the study with a summary of the findings, a discussion of the findings, theoretical and practical implications, limitations of the study, recommendations for future related research, and a conclusion. The chapter concludes with the researcher's final thoughts.

Summary of Study

This study, which used both quantitative and qualitative methods, examined how educators in urban areas of the Midwest perceived changes in their students' interest in STEM subjects, the development of soft skills, and signs of trauma from the pre-pandemic period (2018-2019) to the post-pandemic period (2022-2023). Nonprobability sampling was used along with snowball sampling, as the survey was shared with qualifying educators. The survey consisted of two parts. Part A featured 42 STEM educators who were surveyed, all of whom were taught before and during the pandemic, mainly from Ohio and representing elementary, middle, and secondary levels. Part B featured ten of the 42 participants chosen based on the information they shared in their open-ended responses. These participants took part in a more in-depth interview of 13 questions focused on STEM education and related soft skills, urban education, COVID-related mandated shutdowns, and the pandemic effect on education.

Summary of Findings

The study's findings are organized into research questions and corresponding hypotheses. They are as follows:

Research Questions:

1. How do urban STEM educators rate and describe general student STEM interests from the pre-pandemic to the present?
2. How do urban STEM educators assess and characterize students' soft skills development before and after the pandemic?
3. How do urban STEM educators evaluate and depict the observed signs of trauma in students before and after the pandemic?

Hypotheses:

1. RQ 1: After the pandemic, educators feel that their students' STEM interests have increased compared to before the pandemic.
2. RQ 2: Hypothesis: After the pandemic, educators sense that their students' soft skills have declined compared with before the pandemic.
3. RQ 3: After the pandemic, educators observed more signs of trauma in their students than before.

According to the survey data, the first research question found that educators observed a modest increase in students' interest in STEM subjects. The average rating for STEM interest has increased from 2.92 in 2018 to 3.22 in 2022. Furthermore, educators noted that the gender gap in STEM interest narrowed, with a more balanced distribution of interest between male and female students in 2022 than in 2018. The Chi-Square correlation test showed a significant relationship (p-value <0.001), thus supporting the hypothesis based on the dependence on the two different school years.

The second research question focused on the student application of STEM-related soft skills in the classroom between 2018 and 2022. Ratings for student soft skill usage during the 2018-2019 school year averaged 2.82, with a drop to 2.69 during the 2022-2023 school year. In the open-ended questions, educators also noted a decline in student work ethics, difficulties with critical thinking, and a mixed interest in classroom technology after the pandemic. The Chi-Square correlation test showed a significant difference, with a p-value of <0.001. Therefore, the hypothesis theorizing a drop in STEM soft skills has declined since the pandemic.

Notably, educators have reported a significant increase in signs of trauma among students, with the average rating rising from 3.38 in 2018 to 4.15 in 2022. While trauma was observed equally between genders in 2018, educators reported higher rates among male students by 2022. Educators also described increased instances of depression, anger, suicidal thoughts, behavioral issues, fighting, and substance use among students in the post-pandemic period. The chi-square correlation test showed a p-value of 0.168, suggesting no correlation between the two school years. While the means of the Likert scale ratings support the hypothesis, the chi-square test results do not.

In summary, the study found slight improvements in STEM interest and soft skills and proved the hypotheses correct. The third hypothesis regarding trauma shows data suggesting a rise in trauma signs among urban Midwestern students after the pandemic based on educators' assessments and observations. The study also highlighted shifts in gender differences related to STEM away from a male-dominated field to a sense of equality between genders when considering interest and shifts to both males and females openly showing signs of trauma.

Discussion of Findings

The COVID-19 pandemic has had far-reaching effects on education, particularly in urban settings, where students often face unique challenges. This study investigated the impact of the pandemic on STEM education in urban classrooms, focusing on three key aspects: students' general interest in STEM subjects, their development of soft skills, and the signs of trauma observed by educators. By exploring these factors, this study aims to provide insights into the complex interplay between the pandemic, student engagement, and mental health in urban STEM education.

Research question one focused on urban STEM educators' ratings of students' general STEM interest from pre-pandemic to the present and suggested that there is not much of a change in the general interest in STEM between the school years. However, educators reported higher numbers of female students showing interest in STEM lessons. However, hands-on lessons typically received well and were far more likely to receive engagement than other lessons. The observed students' STEM soft skills suggested a lack of persistence when challenged and a general avoidance of critical thinking due to difficulty.

The second research question focused on urban STEM educators' ratings and descriptions of student soft-skills development from pre-pandemic to the present, suggesting common themes that affect the development of soft skills, including little to no student engagement, with many interruptions related to student home lives. There is a shift from students using STEM soft skills to being higher in the 2022 school year than in the 2018 school year, as well as a shift from more males preferring STEM lessons to a

more equal divide between male and female students. Along with a less challenging curriculum, it was still difficult to motivate students to learn.

Research question three focused on educators' ratings and descriptions of the observed signs of trauma in classrooms. The findings suggest that more male and almost no female students showed signs of trauma in the 2018 school year compared to the 2022 school year, where the signs came from an equal number of male and female students. Educators observed an increased amount of anxiety and a general fear of attempting challenges alongside unattended mental health concerns. Students were quick to share life stories with educators. The culture of urban neighborhoods was more persistent in the classroom, such as open discussions of poverty and trauma-inducing events. Widespread observation includes a sharp increase in violence among students.

Implications

Trauma can affect humans, causing new barriers and adversities that may not have previously existed (The Learning Hindrances of Stress and Trauma, 2019). Urban students are at higher risk of experiencing multiple traumatic events within their lifetime (Horowitz et al., 1995). The sudden pandemic changes may have led to shared traumatic events, which allowed the researcher to collect data on STEM interests and soft skills development to find any common descriptors between STEM interests, soft skills development, and trauma in urban schools. Significant implications of the findings include the relationship between STEM interest and soft skills, the effect of the increase in technology usage, and the impact of social media on students.

STEM Interest and Soft Skills

These results further support the idea that while urban students have yet to experience substantial changes in STEM interests or soft skill application, the interest is now coming forth with more diversity within genders. One of the most notable observations of participants was the students' lack of work ethic and classroom anxiety; however, participants also noted an increase in positive reception with students presenting with soft skills, as defined by Jolly (2014). These results suggest an association between urban students' general STEM interests, which can be more effective when paired with their skills.

These findings are consistent with the findings of Autumn Ruddy, who stated that creating and implementing real-world problem-based lessons will allow students to learn from their own lives. This application process helps solidify the problem-solving skills of each student (2014). These findings also support those observed in earlier studies on the ability of hands-on learning lessons to increase student retention and build student confidence (Arnholz, 2019). The engineering design process has been proven to use advanced problem-solving skills that may be needed in a career that requires them to handle complex issues that may arise (TeachEngineering, 2022). These results align with Hefty's finding that teamwork in the classroom is likely to foster necessary lifelong skills, such as communication (2015). Finally, these findings also complement those of students who feel that they have a say in their education and are more likely to be engaged, which can result in better grades and understanding (Wagoner, 2019).

When considering STEM interest in students, there is a distinction between "interest" and "engagement." Interest in STEM could involve self-led learning and related career goals while engaging in an individual lesson does not directly correlate to

how a student plans to proceed with their knowledge outside the classroom. A student can be engaged in a STEM and not have a long-term interest in STEM. While this is a critical difference in terminology, it was not explained to the participants and may have shifted individual comprehension of the survey questions.

Increased Technology Exposure

It seems possible that the results are due to an unfathomed change in general STEM interest and soft-skill applications when considering a class. However, the increased use of technology (an observation mentioned by participants) during the pandemic may have led students to accept the current technological age. While the reason for this is not apparent, it may be related to the increased use of technology to complete schoolwork and students' use of social media during mandated shutdowns (Cerenelli, 2020). The data must be considered alongside the third research question regarding trauma findings. The rise in trauma among students found in this study suggests more classroom disruptions that impact student learning. Pandemic-induced trauma is not just a quick moment of threat and fear but rather an impression-causing issue, such as brain damage, self-esteem, and self-regulation skills in everyday life (Perkins & Graham-Bermann, 2012). Trauma can also create scars that can be permanently left in the brain (Sandi, 2013). The pandemic is traumatic worldwide (Sanchez-Gomez et al., 2021). Although these students struggled with their own experiences, the COVID-19 initial shutdown often saw children under 18 without proper care, support, and sometimes even food (Kamenetz, 2022). Furthermore, studies have also focused on students' classroom mannerisms after experiencing a traumatic event that impacted their ability to function in everyday life, including in the classroom (Bandura, 1977).

Social Media

These studies related to Bandura's theory of social learning, which concludes that students who gather will learn social behavior from their classmates. With the mass shutdown, students were subjected to trauma and a lack of social learning. However, social media may have impacted students' social learning, as it acted as a method of socialization for students during the mandated lockdown. The use of social media platforms such as Instagram, Facebook, and TikTok grew exponentially during the pandemic-mandated lockdowns. This increase in screen time by school-aged children leads to a growth of mental health issues, including anxiety and depression (Duerden et al., 2024). Lack of socioeconomic learning was a critical observation of the participants in this study. These observations and research suggest that Bandura's social learning theory requires face-to-face social interaction to learn and replicate behaviors. Through virtual-only interactions, students received a small glimpse at others' behaviors. These glimpses, either through social media or calls, have less time involved than being with another person, limiting the student's ability to make observations that can impact their behaviors.

Suggestions

The three themes of future implications involve the relationship between educators' perspectives of STEM interests and soft skills, increased technology exposure, and social media.

Although educators reported students as having lower levels of application of STEM soft skills, there was an increase in STEM interest. Despite struggles, it would benefit students to continue to use STEM pedagogies such as problem/project-based

learning (Ahmad, 2023). Using these skills allows the students to continue practicing soft skills necessary in the modern-day workforce (Ahmad, 2023). Without continuous practice, the skills will not improve and will decline. To prevent soft skill decline, it is suggested that lessons that encourage soft skills are practiced regularly with increasing levels of challenges (Merlin, J.L. & Correll; S.J., 2022).

Increased technology exposure does not just refer to the ensured availability of technology by schools during the onset of the pandemic. It also refers to the accessibility of mobile phones, gaming systems, and other electronic device. Students who missed school due to the pandemic are more likely to struggle with an addiction to their phones. A current choice facing schools today is the ban on cell phones. While phones are disruptive in class, they are still a means of technology (Moraes, 2023). Overusing a phone can lead to social isolation, negatively impacting academic success (Zeng, et al., 2022). To act against technology addiction, it is suggested that students be taught when and where it is appropriate to use their phones, such as when a teacher has a student looking up a quick fact during inquiry-based learning or when work is completed.

Social media, usually accessed through cell phones, has made communication limitless. Anyone can contact anyone within seconds. The increased use of social media and being in contact with friends and family has made it difficult for students to know when to pause or stop a virtual conversation to participate in their learning (Zeng et al., 2023). While social media can be used to encourage education, when done correctly, it has been found that the teaching process is competing with the amount of information also being taken in by social media within a day, which makes it more challenging to commit academic lessons to memory (Papademetriou et al., 2022). Along with the

suggestion mentioned above regarding cell phones, a lesson regarding the natural consequences of posting on social media inappropriately is required to ensure students are aware of the gravity of their interest presence.

Theoretical and Practical Implications

This study focuses on the theoretical findings of Bandura's social learning theory (SLT) and Dewey's progressive educational pedagogy. Bandura's social learning theory provides a strong understanding of the impact of social interaction in academic settings (1977). Dewey's progressive education focuses on allowing students to explore and learn through exploration and inquiry, along with hands-on experience (1938). These two theories provide a solid foundation for understanding the effect of the pandemic and its related mandates and the general benefits of STEM education.

Bandura's understanding of students' impressions of learning based on their social lives provides insight into how students learn non-academic structures in school, such as routines and mannerisms. As many schools turned to virtual education that provided some interaction between students, peer connections were far more limited than what was previously readily available for students before the pandemic. These limited interactions provide students with opportunities for social learning (Seth-Parmar, 2023). Evans-Winters (2011) found that urban students have strong resiliency when using community resources, such as recreation centers and libraries, that expose students to a variety of social situations. They also found that students who exhibit resiliency often say they learn life lessons from those around them, including family, educators, and their community (Evans-Winters, 2011). These social situations and support systems are critical when identifying how a student learns through behavioral modification, as explained by

Bandura (1977). Social learning theory suggests that social interactions can lead to student modifying their behaviors to match those around them, allowing the behavior to be practiced through reproduction. Social learning advances student learning, which also can be exemplified in teamwork. Teamwork is a crucial characteristic of STEM education (Jolly, 2014). Using teamwork in STEM classrooms can help students learn through their classmates, encouraging a better understanding of social norms and academic themes.

Dewey theorized that student interests and hands-on education should be used for authentic learning and engagement (1938). Hands-on education is a crucial characteristic of STEM education, as it teaches students to apply skills rather than traditional reading and lecture-style education (Jolly, 2014). Dewey (1938) argued that student problems and studies should be realistic and authentic so that students understand the purpose of engaging in them. This application to real-world problems is another characteristic of STEM education, which demonstrates Dewey's strong ideas, setting the stage for the development of STEM in modern classrooms (Jolly, 2014).

This study found an increasing post-pandemic STEM interest in Midwestern urban students. Research questions one and two found that students' soft skills remained similar but better responses to hands-on learning while still finding the required soft skills, such as teamwork and making their inquiry difficult. This aligns with Dewey's belief that progressive education engages students. Although students hesitated to use STEM-related soft skills, they still responded positively to STEM lessons in the classroom.

As these students have mostly returned to the classroom at the time of this paper's writing, it is critical to note research question three's findings of a rise in classroom

issues, including behavior. Students in the Midwestern states were part of mandated shutdowns, resulting in a lack of social integration. This relates to Bandura's SLT, as it states students' learning norms. Without these interactions, students would lose valuable life lessons typically gradually learned in classroom settings.

These findings can encourage using more hands-on and inquiry-based learning pedagogies in classrooms. Educators could engage urban students better using STEM practices in and outside STEM classrooms, leaving less time for violence. As STEM soft skills include real-world application, hands-on learning, engineering design process application, teamwork, and inquiry-based learning, these skills can all be interdisciplinary by embracing more communication in the classroom with students.

Limitations of the Study

At the time of this research, there were multiple uncontrollable limitations. The United States needs more teachers (Natanson, 2022). Finding experienced educators from the pre-pandemic to the current pandemic period was difficult. A secondary limitation is the national average of educators' time spent in urban schools, which is three years (Kamrath & Bradford, 2020). The researcher compared the education year of 2018-2019, as it was the last year unaffected by a global pandemic, through the 2022-2023 school year, where almost 50 million students are back in an educational setting (Vestal, 2021). Note that the term educator is used in the study, as all participants were in education and had the opportunity to observe STEM in classrooms, whether as teachers or administrators. Including these administrative positions in the study may skew results due to their removal from the classroom environment and indirect contact with students.

Finding participants was a challenge as educators shifted during the pandemic. Some participants may have earned a promotion, moving them out of the classroom and into an administration role, which may skew some answers (Rosborg, 2022). As the researcher is an insider to the study, many of the participants were found through the school's approvals and by word of mouth amongst the school to encourage qualifying educators to participate. The study was offered to administrators to gauge the overall reactions of how students' skills appeared after returning face to face. However, this posed a minor problem, as not all administrators felt well-versed in how STEM was conducted in school classrooms. Another limitation faced was the K-12 age gap in educators, as the level of STEM was utterly reliant on the grade level standards and how the educator chose to present each standard. All information was provided through virtual surveys, which could influence the results with a specific perspective that is subjective through the collected qualitative data.

Limitations of the methodology include the sampling method and validity and reliability issues related to the need for more literature. The sampling method was sent to the schools and shared; however, most participants were Ohio-based. As a study comprising all Midwestern states, the heavy influence on Ohio-based educators may only partially respond to the experience of some Midwestern educators. The validity and reliability of the study are limited because of the need for comparable data. The pandemic is still recent at the time of this study; therefore, studies have yet to be published regarding education during and after the pandemic.

Another limitation of the study is the need for more consideration of the differences in school typology, such as public vs. private schools. This can be conflicting,

as the variables may appear skewed by the different experiences of educators. The school's socioeconomic status is an additional limitation as there may be differences in available resources, teacher quality, and overall demographics of the students. These varied factors can influence the students' quality of education and impact the generalizability of study findings. Without the control or preference over participants' school differences in typology and socioeconomic statuses, determining whether the results and perspectives of the educators are due to the study's variables or are caused by more deeply rooted uncontrollable circumstances of the individual schools is difficult.

Recommendations for Future Research

The findings of this study suggest that gender diversity and inclusion are becoming more prevalent in the historically male-dominated STEM sector. These changes are significant and call for additional research to better understand the aspects of the shift. A deeper understanding of the gender shift and trauma effect on students who will one day be the primary workforce of society is critical to educating them. Exploring the implications for STEM education, it is essential to consider the potential impact of these changes on STEM careers and future opportunities for students. These findings can shift student interest and participation, potentially affecting the future of STEM fields and the workforce.

Further research is necessary to understand and adapt to these emerging trends within the educational realm. Research to better understand the severity and longevity of trauma in post-pandemic education will be a constant need for humanity as the worldwide event becomes further in the past. A comparative study of education in the world after the last pandemic of the Spanish Flu in 1918 to the COVID-19 pandemic

might be beneficial for predicting student trends. While STEM continues to grow as a significant discipline in the educational realm, it is necessary to understand how students' lives, whether traumatic or not, can affect their education. Studies along these lines could lead to better methods of providing aid and effective, applicable education to improve students' lives.

This study included students from kindergarten through 12th grade. Future studies could examine the difference between grade and even school levels, such as collecting data only from middle school educators. Factors such as classroom culture and environment can also affect a class's disposition.

Conclusion

The pandemic was experienced across the globe and impacted many facets of daily life. This study aimed to determine whether STEM educators rated and described general student interest in classroom STEM lessons, the application of STEM-related soft skills, and signs of trauma in the classroom. This mixed methods study compared the experiences of educators who have taught before and after the pandemic. 42 Participants across the midwestern United States took a Likert scale survey to gauge student STEM interest first by observations from the 2018-2019 school year compared to the 2022-2023 school year, followed by whether female or male students were interested in the two critical school years. Related questions were then asked to focus on student application of STEM soft skills and signs of trauma.

The study found that quantitative data regarding any increase or decrease in general STEM lessons or the application of STEM soft skills needed to be numerically significant. However, the findings regarding both topics found a shift from males, typically being more interested in classroom STEM lessons and better STEM soft skill

applications, to being more equally now distributed. The third research question's findings included a slightly higher rate of trauma signs in the classroom. Participants also noted the shift from males previously having shown more signs of trauma to those better shown by a more equally gender-diverse group.

The initial survey featured open-ended questions that allowed educators to share observations of student changes. Ten of those educators were asked for a follow-up interview to fully understand the extent of the pandemic's effect on general STEM student interest and STEM soft skill application, along with findings regarding trauma. Of the data collected, 17 educators provided key terms that created five additional sub-categorical findings related to the definition of STEM soft skills as defined by Jolly (2014). These sub-categories included real-world applications, hands-on learning, engineering design process applications, teamwork, and inquiry-based learning.

The survey and follow-up interview findings identified vital terms that led the researcher to identify the three categories based on each research question. These terms included students' lowered work ethics, homelife interference, violence, anxiety, and many more. The phrases used by participants aligned with each STEM essential character category while being well supported by previous STEM interest and soft-skill-related studies. The findings of trauma revealed correlations between the lasting effects of trauma on the brain that result in hardship in academic settings. The pandemic's mandated shutdowns drove the world into isolation, causing a traumatic global event.

Understanding the effects of the pandemic on the mental health of school-aged children can lead to better processes and pedagogy in education. Using proven methods such as STEM education can help overcome barriers established by the lack of

socioemotional learning, which has become widespread in classrooms today. Students need to know that they are not behind or lacking because of anything they have done but instead because of a massive, unprecedented event beyond anyone's control. That is, there is no fault. What can be done to address this- well, that can be someone's "fault." With the knowledge that students typically respond well to STEM lessons using STEM soft skills, they can grow into well-rounded adults and members of society. This study has opened the door to using STEM lessons to aid students with trauma. It is up to each reader to cross this threshold.

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Appendix A

Letter of Exempt Status from the Youngstown State University Institutional Review Board

From: do-not-reply@cayuse.com
Subject: 2023-269 - Initial: Initial - Exempt
Date: June 28, 2023 at 2:42 PM
To: cnstoll@student.ysu.edu, rdrock@ysu.edu

YOUNGSTOWN STATE UNIVERSITY

Jun 28, 2023 2:42:03 PM EDT

Rodney Rock
Teacher Ed and Leadership St

Re: Exempt - Initial - 2023-269 Teachers' Descriptions of Urban STEM Students' Academic Achievement and Mental Health: Pre- and Current Pandemic

Dear Dr. Rodney Rock:

Youngstown State University Human Subjects Review Board has rendered the decision below for Teachers' Descriptions of Urban STEM Students' Academic Achievement and Mental Health: Pre- and Current Pandemic

Decision: Exempt

Selected Category: Category 2.(i). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

Any changes in your research activity should be promptly reported to the Institutional Review Board and may not be initiated without IRB approval except where necessary to eliminate hazard to human subjects. Any unanticipated problems involving risks to subjects should also be promptly
reported to the IRB.

The IRB would like to extend its best wishes to you in the conduct of this study.

Sincerely,
Youngstown State University Human Subjects Review Board

Appendix B

Questions from Part A Survey

Educators Descriptions of Urban STEM Students Academic Achievement and Mental Health in the Pandemic

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Start of Block: Block 2

Q1 INFORMED CONSENT
Dear Participant: I am Cody Stoll, a doctoral candidate at Youngstown State University. I am studying how Midwestern urban school educators rate and describe STEM students' soft skills development from the Pandemic's beginning to the present. This study includes two parts: a survey and an interview. In the survey, you will be asked to rate and describe students' STEM skills based on in-school observations. In the survey, for data analysis purposes, I will collect information to describe you, such as your name, email address, and school district. In analyzing the survey responses, I will look for variability in responses. Those respondents who show the most significant differences in their ratings of students' soft skills development (improvement or decline) will receive from the researcher a follow-up email requesting their participation in video interviews. Although I will use all completed surveys to report results, I will not include any personally identifiable information. Your participation should take no more than 30 minutes. Upon analysis of the survey data, I may contact you for a follow-up, zoom interview, which I will record. Your participation should take at most 20-30 minutes each time. I will use the interview data to identify common themes. It is unlikely that this research will put you at risk of harm. Contact information is required; however, I, the researcher, am the only one with access to this information. Thus, there is minimal potential for negative repercussions for participants within the study. Safeguards in place to protect your identity include using pseudonyms in storing, analyzing, and reporting results. All information collected during the study will be kept on the virtual survey collection service, Qualtrics; in Zoom; or on the researcher's personal computer, each of which is accessible only by the researcher via password. The researcher will destroy all study data after three years. The benefits to you of participating in this study include aiding in research to inform post-pandemic practices. Your privacy is important, and I will handle all identifying information confidentially. The project's results will be presented in ways that will not identify you. I plan to present the study's results at educational conferences and publications. You do not have to be in this study. If you choose not to, you can say no without losing the benefits entitled to you. If you agree, you can stop participating and withdraw at any time. If you have any questions about this research project, please

contact Dr. Rodney Rock at rdrock@ysu.edu. If you have questions about your rights as a participant in a research project, you may contact the Office of Research Services at YSU (330-941-2377) or at YSUIRB@ysu.edu. By signing below, you indicate that you understand the study described above, have been given a copy of this consent document, teach STEM topics in an urban district, are 18 years of age or older, and agree to participate. You also understand that you may be digitally recorded for research accuracy.

By selecting yes, I agree to participate.

- ○ Yes, I agree to participate. (1)
- ○ No, I would not like to participate. (2)

Q2 Using the above, I agree to be recorded for the interview.

- ○ Yes, I agree to being recorded. (1)
- ○ No, I do not agree to being recorded. (2)

End of Block: Block 2

Start of Block: Contact Information

Q3 Are you located in the Midwestern Region of The United States of America?

- ○ Yes (1)
- ○ No (2)

Q4 Are you an educator in an urban community?

- ○ Yes (1)
- ○ No (2)

Q5 Contact Information-
Please include:
Name
City & State
School System
Email

_____

_____

_____

_____

_____

Q6 Have you been working in Education since at least 2018?

- ○ Yes (1)
- ○ No (2)

Q7 What is your position where you are using or have previously used STEM lessons or aspects when working with students?

- ○ Science or Math Teacher (1)
- ○ Educational Aide (2)
- ○ Administration (3)
- ○ Other- Please Explain (4)

_____

End of Block: Contact Information

Start of Block: Data Collection

Q8 How would you rate the STEM soft skills of students in the 2018-2019 year?

STEM Soft Skills include teamwork, communication, problem-solving, and other related skills.

	Very Poor	Poor	Neutral	Strong	Very Strong
	1	2	3	4	5
Click to write Choice 1 ()					

Q9 How would you rate the STEM soft skills of students in the 2022-2023 year?

	Very Poor	Poor	Neutral	Strong	Very Strong
	1	2	3	4	5
Click to write Choice 1 ()					

Q10 In the 2018-2019 school year, in your experience, were males or females more likely to use STEM soft skills?

- Females (1)
- Males (2)
- Equally split (3)
- N/A (4)

Q11
In the 2022-2023 school year, in your experience, were males or females more likely to

use STEM soft skills?

- ○ Females (1)
- ○ Males (2)
- ○ Equally split (3)
- ○ N/A (4)

Q12. Please explain any additional information regarding the change in students' application of STEM soft skills between 2018 and 2023.

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Page Break

Q13 Please rate how commonly students show signs or speak of trauma during the 2018-2019 school years.

Trauma signs include lack of self-care, open discussing anxiety or depression, difficulty focusing, and other signs that might suggest a higher level of concern and uncertainty.

	Very Poor	Poor	Neutral	Strong	Very Strong
	1	2	3	4	5
Click to write Choice 1 ()					

Q14 Please rate how commonly students show signs or speak of trauma during the 2022-2023 school years.

	Very Poor	Poor	Neutral	Strong	Very Strong
	1	2	3	4	5
Click to write Choice 1 ()					

Q15 In the 2018-2019 school year, in your experience, were males or females more commonly observed showing signs of trauma?

- ○ Females (1)
- ○ Males (2)
- ○ Equally split (3)
- ○ N/A (4)

Q16 In the 2022-2023 school year, in your experience, were males or females more commonly observed showing signs of trauma?

- ○ Females (1)
- ○ Males (2)
- ○ Equally split (3)
- ○ N/A (4)

Q17 If applicable, please provide details of changes in observed signs of trauma.

_____

Page Break

Q18 Please rate the perceived interest in pursuing a STEM degree or career change, if at all, during the 2018-2019 school year.

STEM Degree or Career Change would include what kind of jobs a student is interested in post-secondary.

	Very Poor	Poor	Neutral	Strong	Very Strong
	1	2	3	4	5
Click to write Choice 1 ()					

Q19 Please rate the perceived interest in pursuing a STEM degree or career change, if at all, during the 2022-2023 school year.

	Very Poor	Poor	Neutral	Strong	Very Strong
	1	2	3	4	5
Click to write Choice 1 ()					

Q20 In the 2018-2019 school year, in your experience, were males or females more commonly showing interest in pursuing a STEM career?

- ○ Females (1)
- ○ Males (2)
- ○ Equally split (3)
- ○ N/A (4)

Q21 In the 2022-2023 school year, in your experience, were males or females more commonly showing interest in pursuing a STEM career?

- ○ Females (1)
- ○ Males (2)
- ○ Equally split (3)
- ○ N/A (4)

Q22 If applicable, please provide details about perceived change in STEM careers.

_____

End of Block: Data Collection

Appendix C

Questions from Part B Interviews

STEM education and related soft skills:

- STEM has become increasingly important over the past decade. Can you provide examples of your STEM lessons and how students receive them?
- It has been said that the STEM field requires more hands-on work and critical thinking. How did/do your students react to using aspects of STEM in the classroom?
- The pandemic significantly affected educators, as every lesson was taught. How did you teach those same STEM soft skills during 2020's shift to virtual education?
- Do you feel like STEM activities have changed in the classroom since the pandemic? Do students engage or show the same interest during these lessons as before the shutdown?
- Virtual education became the vehicle for academics during the pandemic and in current-day classrooms. Has the enforced use of technology affected students' ability to become engaged with STEM lessons?

Urban education:

- There are stigmas around teaching in urban schools. What are the biggest challenges for you as a teacher in urban schools?
- Given the challenges mentioned, how do other aspects of their lives influence these students? Please give insight into observed signs of trauma, home life, hobbies, attendance, IEP/RTI intervention frequency, or anything else you

have observed. Have these challenges changed at all compared to the 2018-2019 school year?

- No two students are alike and often come into a classroom with a predisposition toward learning. What is the general attitude of your students toward learning?

Possible effects of pandemic-mandated shutdowns:

- After mandated shutdowns, students had to re-learn how to be in the classroom. Since returning to the classroom, what changes have you seen in the students?
- Students thrive on constancy; in some cases, teachers are the only constancy a student may have, leading to a trusting relationship. Do students in your classroom tend to share their personal experiences, trauma-related or not, openly with you or during class? Do you think your students usually trust you?
- Students who have experienced trauma can be reluctant to interact with new people, such as educators. Please examine if you have experienced any withdrawn students for whom trauma was an issue.

Pandemic effect on education:

- Many schools turned to virtual education during mandated shutdowns. How did the overall virtual class meeting time feel for you? How much did you have to change the curriculum to keep students engaged?
- Most schools have returned to physical classrooms during the 2022-2023 school year. During your first full year back with students face to face, were

there any new challenges you or your students faced due to the transition back to the classroom?