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The effect of math tracking on students' growth mindsets

Amber Lawrence
University of Northern Iowa

THE EFFECT OF MATH TRACKING ON STUDENTS' GROWTH MINDSETS

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Amber Lawrence

University of Northern Iowa

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Date Dr. Elizabeth Hughes, Honors Thesis Advisor, Mathematics

Date Dr. Jessica Moon, Director, University Honors Program

Abstract

This study investigated the effects of tracking in math classes on students’ growth mindset in math. A survey was given to students to evaluate their growth mindset in a quantitative way. Students in the 6th, 7th and 8th grade were surveyed. The 6th grade students had not been officially tracked, the 7th grade students were in their first year of tracking, and the 8th grade students had been tracked for over a year. A one-way analysis of variance was performed and showed a statistically significant difference between the growth mindset scores of the students by grade level. A Student’s T-Test was performed and found that students in the 8th grade had statistically significant lower growth mindset scores when compared to students in the 6th grade. These results indicate that tracking could be negatively influencing students’ growth mindsets and shows that further research into the effect of tracking on students’ mathematical mindsets should be performed.

Introduction

Mindset and tracking are both important concepts in education. In recent years, there has been much research done over mindsets and the views students have about their ability to improve their intelligence. Many schools have implemented initiatives to improve the mindsets that students hold. Tracking is a common practice in math in the United States with a majority of students in the United States being placed into tracked math classes by 8th grade (NCTM, 2018). However, the practice of tracking contradicts growth mindset messages. Growth mindset messages encourage students to believe that anyone is capable of high-level learning and that a person can always improve, while tracking places students in unmovable, ability-based groups.

Tracking could be causing students to hold more fixed mindsets and lose out on the many advantages that are associated with a growth mindset such as increased self-efficacy, higher achievement levels, and greater perseverance (Dweck, 1999; Sun, 2018b; Boaler, 2013). A growth mindset is very valuable to students both academically and mentally and should be encouraged in all students.

No research has yet been done on the effects of tracking in math on the mindsets students hold. This study was designed to fill that gap by analyzing the possible impacts of tracking on students' growth mindsets. If the results show that tracking harms students' mindsets, then it indicates that a more critical view of tracking needs to be taken in order to decide if tracking is really beneficial to students or necessary in the education system. This study aimed to find if the direct and indirect messages that tracking sends to students could cause students to hold more fixed mindsets.

Literature Review

Growth Mindsets

Dweck pioneered research in mindsets by studying how students responded to failure (Dweck, 2006). She found that there were two main mindsets that students had. Some students responded positively to failure and saw it as a learning opportunity and others gave up. Dweck termed these two views as "growth" and "fixed" mindset. Students with a growth mindset believe that they can increase their intelligence through exercise and practice while students with a fixed mindset believe their intelligence is static (Dweck, 1999). Students can also hold a mix of the two mindsets. Research has found that 40% of students hold a growth mindset, 40% hold a fixed mindset, and 20% have a mix of the two (Boaler, 2013). There are many positives that come from students having a growth mindset. These students have more "grit," higher self-efficacy, and greater achievement when compared with their fixed-mindset peers.

Students with a growth mindset are more likely to persist in a tough situation (Boaler, 2013). This is important in school where students will have to face many problems. Students with a growth mindset are more willing to face challenges and persist longer when encountering challenges (Boaler, 2013; Sun, 2018b). This is because these students do not view failure as a reflection of their own intelligence. In contrast, students with a fixed mindset do well when the material comes easily but struggle when they face challenges (McCutchen, Jones, Carbonneau, & Mueller, 2016). In today's schools, and today's world, students will be facing many challenges and need to be able to handle them head-on and persevere through them.

A student's belief of their ability to achieve their goals is their self-efficacy. Research suggests that mindset influences the development of self-efficacy for individual students (Dweck 1999; Komarrgju & Nadler, 2013). Students with a growth mindset have a higher sense of perceived self-control of their future academic achievement (Yeager & Dweck, 2012). This is beneficial to students because when students believe that effort leads to achievement, then they will put in more effort. Growth mindset students also are able to use more adaptive coping strategies when faced with stress (Burnette, O'Boyle, VanEpps, Pollack & Finkel, 2013; Doron, Stephan, Boiche, & Le Scanff, 2009). In contrast, students with fixed mindsets have "been associated with poorer emotional states and coping strategies, such as greater worrying about performance on an upcoming test and greater negative effects regarding general academic ability, including anxiety, shame, and hopelessness" (Degol, Zhang, & Allerton, 2017, p.979). Students benefit in many aspects of their life from having a greater self-efficacy.

A growth mindset also impacts student achievement and learning. Students with a growth mindset achieve at higher levels academically (Sun, 2018b). This is likely because these students persist longer when faced with challenges. A growth mindset also leads students to learn the material better (Yeager & Dweck, 2012). Students with a growth mindset are not discouraged by mistakes but see them as a learning experience. They also believe that they can control their intelligence and so they put more effort into learning the material. McCutchen et al. (2016) explains, "Students who believe they will do well are willing to try harder than students who are not expecting to do well, which may then increase academic achievement" (p. 2019). A student's' view of their intelligence can be a self-fulfilling prophecy and can make an impact on their achievement.

A growth mindset is especially important for disadvantaged students. A students' socioeconomic status is a strong predictor of achievement, but it has been found that a growth mindset helps students at low-socioeconomic statuses achieve at levels of students in high socioeconomic statuses. In fact, "students in the lowest 10th percentile of family income who exhibited a growth mindset showed academic performance as high as that of fixed mindset students from the 80th percentile" (Claro, Paunesku, & Dweck, 2016, p. 8664). When intervention is used to encourage a growth mindset in students with a fixed mindset, they begin performing at higher levels immediately (Boaler, 2013). A growth mindset is important to a students' learning and academic achievement.

Growth Mindset in Relation to Math

A student's mindset is not consistent among all subjects and areas of their life. Students are able to hold different mindsets for different subjects (McCutchen et al., 2016). This means that the mindset a student holds about their language arts ability might not be the same mindset they have about their math ability. However, a student's mindset in one subject can influence their mindset in others (Allen & Schnell, 2016). The mindset a student holds in math could affect how their see their overall intelligence or their belief in their ability to learn other subjects. Math is the subject where it is particularly common to hold a fixed mindset belief (Boaler, 2010). Allen and Schnell (2016) found that, "Most people think they are either born with or without math ability, something they essentially cannot change" (p. 400). This is commonly seen when someone explains that they hate math and just "don't have the brain for it."

This misconception about math intelligence is especially damaging among math educators because of the impact it can have on their students and, unfortunately, it is common among them (Leslie, Cimpian, Meyer, & Freeland, 2015; Anderson, 2018). This leads to educators, often unknowingly, communicating fixed mindset messages about math to students. A common way this might be done is saying to a student "It's okay you're not good a math, you're good at other subjects." This sentiment is meant to be kind but instead it communicates to students that they cannot do math and that they should focus on what they are good at. Instead, educators should be encouraging students that, with effort, they can improve in their math abilities.

The commonly held belief that people are either born with a gift in math or are not is false. Neuroscience has shown that math is a subject that like all others, is learned through hard work and patience (Anderson, 2018). Boaler (2016) added, "New evidence from brain research tells us that everyone, with the right teaching and messages, can be successful in math, and everyone can achieve at the highest levels in schools" (p. 4). Research has shown that all students can achieve in math and this is the message that teachers need to be communicating to students.

A student's mathematical mindset is crucial to their success. Mathematics identity is important to students and their framing of their knowledge, skills, beliefs, and relationships with math (Allen & Schnell, 2016). As explained above, mindset is an important factor to student achievement. A growth mindset in math increases the level that students perform at and increases students' value and enjoyment of their learning (Boaler, 2013). This is important because not only should students learn at school but they should develop a love of learning. Degol et al. (2017) found that, "mindset positively predicted value, demonstrating that the more an adolescent ascribed to a growth mindset in math ability, the more they valued math" (p. 985). This benefit would lead to more students seeing the value of math and wanting to continue into advanced math classes and math-related career fields.

The students that are most helped by having a growth mindset in math are the ones who are often stereotyped as not being successful in math. Students with growth mindsets are less susceptible to negative stereotypes about their gender and race (Anderson, 2018). Students commonly stereotyped as not having the "gift" needed to achieve in math are African Americans and girls. In one study, growth mindset has been shown to increase academic performance, especially for youth affected by stereotypes of underperformance in academics (Degol et al., 2017). In another study performed by Boaler, when growth mindset intervention was used it helped to reduce the gender and racial gaps in achievement levels. In fact, it was found that "gender difference in mathematics performance only existed among fixed mindset students" (Boaler, 2013, p. 146). This shows the impact that mindset has on students' achievement. These studies all show the importance of holding a growth mindset in math for students who are commonly stereotyped as not having the gift for math.

The reason that holding a growth mindset might be so beneficial to these students is because a fixed mindset can lead to anxiety and "People's fear and anxiety about doing math - over and above actual math ability- can be an impediment to their math achievement" (Beilock, Gunderson, Ramirez, & Levine, 2011, p. 1860). Students with a fixed mindset hold more anxiety about math because they believe their math ability is static and that if they make a mistake, it proves their lack of intelligence. However, once they develop a growth mindset, they realize that mistakes do not reflect their intelligence and there is less fear about math, allowing them to show their higher math ability.

Tracking

Students are indirectly told fixed mindset messages about math from society and their peers, but tracking is reinforcing this idea even more. Tracking is a form of ability grouping and is a controversial issue in education (Trautwein, 2006). Tracking is when students are placed in different classes based on their perceived ability (Slavin, 1987). Students who are perceived as being gifted are placed in the high-level track, students who are considered average are in the grade-level track, and students who are thought of as struggling at math are placed in the low-level track. Math is the most commonly tracked subject in the United States and students are normally placed in separate tracked math classes in middle school (Boaler, 2013; NCTM, 2018). Middle school is a crucial time when students are developing their identity (Allen & Schnell, 2016). Students should be encouraged to embrace math at this time and not fall into fixed mindsets or view math negatively.

Students might not be explicitly told whether they are placed in the high, middle, or low track but they will find out. Students know who are considered the “smart” ones and who are the “slow” ones and can tell what track they have been placed into (Boaler, 2013). Even very young students can tell what track they are in. In England, it is common to track students in primary school and one student in Year 1 explained that they knew what track they were in because “all the clever students had gone into a different class now” (Boaler, 2010, p. 146). If a 5 or 6-year old student can tell what track they are in, then a middle school student would be able to as well.

The intention of tracking is to allow students to be taught with others at their ability level. But, research shows that tracking harms achievement of the low and middle groups and does not improve achievement of high-attaining students (Boaler, 2013). The National Council of Teachers of Mathematics (2018) says that tracking is “essentially ‘educide’” and should be stopped (p. 17). When schools stop tracking and switch to heterogeneous classes, achievement and participation improves (NCTM, 2018). Tracking negatively affects many students.

Tracking enforces fixed mindset ideas in students. Tracking directly tells students what level of intelligence they have and since students rarely move into a higher track, they are indirectly being told that there is no way for them to improve their intelligence. Students are given the idea that only the top group can handle complex math and the lower group only basic math (Sun, 2018b). This is especially troubling when it is considered that students are placed into tracks in middle school and these students' entire school math career is based off of a test or their teacher's opinion of their ability at that point in time. Allen and Schnell (2016) said, "We cannot say too strongly how important it is for us to reflect continuously on how our own assumptions, and potentially skewed perceptions of students, result in self-fulfilling prophecies" (p. 405). Students might be placed into the wrong track or by placing a student into a low track it can lead to that student achieving at lower levels because the expectations placed on them are low. All students need be held to high expectations and know that their effort can lead to greater achievement.

Teachers cannot communicate messages to students about growth mindset and that all students can achieve while at the same time having students placed in nearly unchangeable groups based on what their intelligence is perceived to be. Instead, heterogeneous classrooms where all students are taught challenging math concepts should be implemented. By providing all students with the opportunity to work on high ceiling, low floor, advanced math concepts, all students are given high expectations and sent the message that they can do high-level math (Sun, 2018a). This will then promote a growth mindset in students about their ability to be successful in mathematics.

Methodology

This study focused on identifying what influence tracking has on the mathematical mindset students hold. A survey of mindset questions relating to math was given to 6th through 8th grade students. The survey used a Likert scale which ranged from strongly disagree to strongly agree. The level of agreement was then converted into a numerical value. This allowed the results to be quantitative and a statistical analysis was run to determine significance. The results of the study were analyzed using a one-way analysis of variance and then a Student's T-test to determine between what two variables the significance occurred.

The null hypothesis of this study was that if tracking had no influence on students' growth mindset scores, then there would be no statistically significant change between the mathematical mindset scores of the 6th, 7th, and 8th grade students surveyed. The alternative hypothesis was that tracking would influence students mathematical mindset scores and that the higher a student's grade level, the lower their mathematical mindset score would be.

Participants in the Study

The participants of this study were 6th, 7th, and 8th grade students from the public school district of Cedar Falls. This district has 5,614 students, pre-kindergarten through 12th grade, and 22.2% of students qualify for free or reduced price lunch. Of the students in the district, 3.6% are considered English language learners (ELL) and 11.8% of students receive special education services. This district has a high graduation rate (96.2%) and has higher than state-level proficiencies in mathematics.

The participants all came from Lincoln Elementary School, Peet Jr. High School, and Holmes Jr. High School. These schools were selected because they were the ones in which the district gave permission for the survey to be conducted. All 6th through 8th grade teachers in these buildings were contacted and permission was requested to conduct the survey in their classes. The survey was conducted in the classroom of three teachers at Lincoln Elementary, three teachers at Peet Jr. High, and three teachers at Holmes Jr. High. At the junior high schools, three of the teachers' class periods were surveyed. A total of nine classes were surveyed at each junior high school, three classes at the elementary school, and a total of twenty-one classes were surveyed from all three schools. All students in these classes were invited to participate in the study. Physical or electronic permission forms were sent to parents and guardians of the students. Students whose guardians gave permission were then able to assent to participate in the survey. A total of twenty-four 6th graders, sixty-eight 7th graders, and fifty-two 8th graders participated in the survey.

In the Cedar Falls School District, most students are not officially placed in tracks until they begin junior high school in 7th grade. However, some 6th grade students from the elementary schools are able to take honors math courses at the junior high schools. At Peet Jr. High, students can be tracked into a low-level, grade-level, or honors courses. At Holmes Jr. High, students can be tracked into a low-level or a grade-level course in 7th grade and a low-level, grade-level, or honors course in 8th grade. Students from each class level were included in the survey of junior high students.

At Lincoln Elementary, students do not have official tracks but 5th and 6th grade students are "soft" tracked. This means students are pre-tested for each unit and placed into different math classes based on their score for that unit. There is a low-level, grade-level, and high-level class. At the start of a new unit, students have the chance to change what class they are placed in based on their knowledge of that unit. So, students could be in a low-level, grade-level, and high-level class all in the same school year. Since students have the ability to move between the different classes each unit, this is not official tracking. Students from each class level were included in the survey of the elementary school students.

Originally, students in 4th, 5th, 6th, 7th, and 8th grade were going to be surveyed in order to receive data on students' mindsets before soft tracking occurred in the 5th grade and after official tracking began in 7th grade. Unfortunately, permission was not able to be received from 4th and 5th grade teachers and so 4th and 5th grade students were not able to be surveyed. Instead, the study focused on students' mindsets before and after official tracking began in 7th grade.

Data Collection

Data were collected using a survey to measure students' mathematical mindsets. Questions for the survey were based on Dweck's (2006) questions used in her studies of mindset. The questions were adapted slightly in two ways. Dweck's questions were designed to address a person's mindset about their general intelligence; the survey questions were modified in order to focus on the mindset the participant holds about their mathematical intelligence. Second, the language was changed to be more accessible to middle school-aged students.

The survey was designed to measure students' mathematical mindsets quantitatively. The design that Claro et al. (2016) used in their study of students in Chile was used as a basis for formatting the survey. A statement was given and then students rated their agreement to that statement using a Likert Scale. The scale included strongly disagree, disagree, neutral, agree, and strongly agree. An example of a statement in the survey is, "You can learn new things, but you can't really change how smart in math you are." See Appendix A for a full copy of the survey given to the students.

To administer the survey, a time was coordinated with the classroom teacher to come into their class. Students whose guardians gave permission for them to participate were given a student assent form, the survey, and verbally told the instructions. A brief introduction of the purpose of the study was given and it was explained that the survey would be anonymous and that the students could decide if they wanted to participate. An explanation of how to complete the survey was given using an example statement that was unrelated to math or mindset. It was explained to the students that there is no right or wrong answer to any of the questions and that they should answer how they feel. If students agreed to take the survey, they signed the student assent form and wrote down their grade level. Students were then provided as much time as needed to complete the survey and the survey administer was there to offer assistance if needed.

Data Analysis and Results

Before analyzing the data, the surveys were separated by grade level and then assigned a number for anonymity. That number was used when scoring the surveys and organizing the data on an excel document. Students who did not complete the entire survey were removed from the data analysis. This left twenty-four 6th graders, sixty-five 7th graders, and fifty 8th graders.

The survey data was evaluated based on the method used by Claro et al. (2016). Using the Likert Scale, the questions' level of agreement was given a value from one to five. A value of one was given to strongly agree and a value of five was given to strongly disagree. Five of the questions on the survey were reverse scored. For those questions, a value of one was given to strongly disagree and a value of five was given to strongly agree. The average of all of a student's responses were their mathematical mindset score. Students with a growth mindset in mathematics had a score closer to five and a students with a fixed mindset in mathematics had a score closer to one. Then, the average numerical score for each grade level was found. The average score for 6th graders was 4.149, for 7th graders was 4.057, and 8th graders was 3.872.

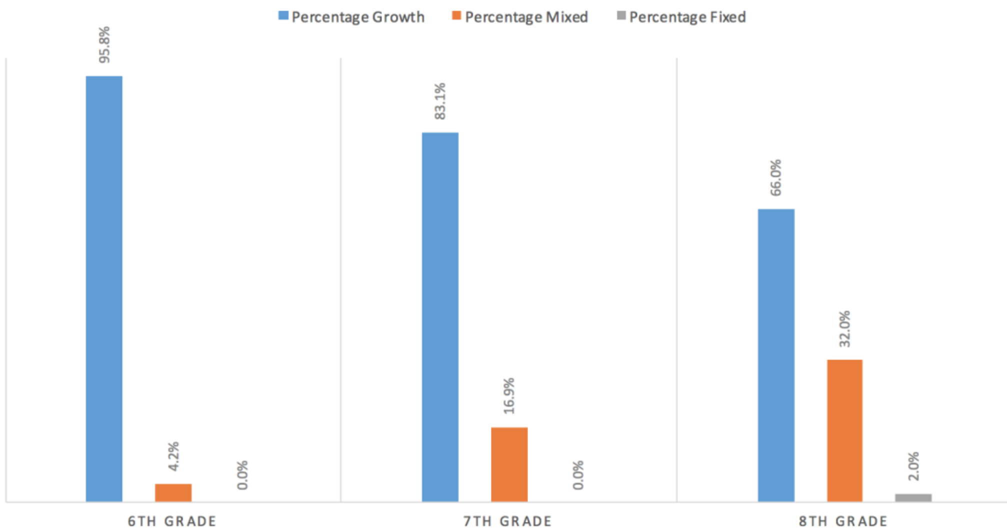
Figure 1

Grade	Population Size	Mean	SD
6th	24	4.149	0.449
7th	65	4.057	0.425
8th	50	3.872	0.577

Analysis using a one-way analysis of variance (ANOVA) was run on the mean data and results showed there was a significant difference between the grade levels (F= 9.903, P= .002). Post hoc tests were run using Student's T-test and found that the significant difference was between the scores of 6th and 8th graders (P= .004). This showed that 8th graders had a significantly more fixed mindset score in math than 6th graders. As a precaution, analysis was also done using an ANOVA on the total score (P= .002), a Kruskal-Wallis test on the mean score (P= .021), and a Kruskal-Wallis on the total score (P= .018). All also found a significant difference between the mindset scores of the grade levels.

The composition of growth, mixed, and fixed mindsets by grade level were also found. Students with scores between 1-2.5 were considered to have a fixed mindset, students with scores between 2.51-3.5 were considered to have a mixed mindset, and students with scores between 3.51-5 were considered to have a growth mindset. The mindset of each student was found. Then the percentage of students with growth mindsets, mixed mindsets, and fixed mindsets by grade level were found. Figure 2 displays the results.

FIGURE 2



Discussion

This study looked at the influence that tracking in math classes had on students' growth mindset in math. Students in 6th through 8th grade were given surveys to gauge their growth mindset scores. The result of this survey showed a significant difference in the growth mindset scores of students in 6th, 7th, and 8th grade. Students in 8th grade had statistically significant lower growth mindset scores compared to 6th grade students. The data supported the alternative hypothesis and rejected the null hypothesis.

Tracking reinforces fixed mindset ideas in students. By placing students into different tracks, it is directly communicating the idea to students that they are either low-level, grade-level, or high-level in math. Students begin to believe the messages that they receive. Even while conducting this survey, one student asked, "Why am I with all the smart kids?" When students are told that they are not smart in math, they listen and they stop thinking that they have any ability to change their math level. If students are told in school, a place whose goal should be to help them learn to their full potential, that their potential is "low-level" then students do not think they can do better than "low-level." A key practice in teaching is holding each student to high expectations, tracking does the opposite.

Tracking can also lead to self-fulfilling prophecies because "students who believe they will do well are willing to try harder than students who are not expecting to do well, which may then increase academic achievement" (MuCutchen et al, 2016, p. 2019). Students placed in low-level tracks are directly being told that their school does not expect them to do well and they cannot handle the content the other students in the higher-level tracks are doing. This can lead to students believing they cannot do well and so they put in less effort and do not do well. What track a student is placed in can affect their ability, especially when you consider the teachers assigned to different tracks. It is common for more experienced and effective teachers to be the ones who teach the highest tracks. This leaves the teachers with the least experience to help the students with the most need (Bush, 2019). Tracking is leading students, who are already perceived to be low-level, to struggle even more in mathematics.

A key part of growth mindset is that students have self-efficacy; they believe that they have the ability to improve their intelligence. These students will put in more effort because they trust that their effort will lead to greater achievement (Yeager & Dweck, 2012). Tracking goes against these ideas. Often only the highest level tracks are taught advanced concepts and skills which implies that the students in the low-level tracks, no matter the amount of effort they put in, will never be able to learn that content (Boaler, 2011). The track students are placed into in middle school impact the classes the students are placed into in high school (Bush, 2019). Students cannot have self-efficacy and believe they can improve their math intelligence when tracking restricts them to the level of math ability they had during one year of middle school.

Students need to be told the message that every one of them can achieve high-level learning in mathematics. Research has found that "everyone with the right teaching and messages, can be successful in math, and everyone can achieve at the highest levels in schools" (Boaler, 2016, p.4). Sending this type of message to students helps them develop growth mindsets and schools should be striving for all students to hold growth mindsets and have the benefits that are associated with them. Tracking sends messages to students that directly go against growth mindset messages.

Growth mindset does not suggest that all students are equal in their ability in mathematics. Students have different levels and different needs. However, growth mindset does suggest that the level a student is at, at one point and time in their life, does not mean they are incapable of ever improving. Tracking removes many students' chance to increase their ability level. There are many ways to help all students succeed that do not include putting those perceived as being low-level at math in separate classrooms. Boaler (2016) suggested heterogeneous classrooms where all students are given low-floor, high ceiling questions. This allows student who struggle in a concept to still be able to complete the problem and students who excel in that concept to go further and deeper into the mathematics of the problem. In this type of classroom, all students are able to believe that they can improve their math ability.

A surprising result from the survey was how high the mathematical mindsets were for all the students surveyed. There was only one student from all grade levels that would be categorized as having a fixed mindset (see Figure 2). All other students had mixed or growth mindsets. The results are especially uplifting when compared with other studies that have found around 40% of students to hold fixed mindsets (Boaler, 2013). This could possibly be influenced by the schools' culture or the home lives of the students. This is something that could be interesting to look into further.

Limitations and Recommendations for Further Research

The original version of this study was not able to be completed. The initial plan was to survey students in 4th through 8th grade in order to analyze students' growth mindsets before they were ever tracked, during soft tracking, and after official tracking began. This would have allowed comparisons to be made between the mindset of students that never had any type of tracking (4th graders) with students who have been officially tracked for at least a year (8th graders). It would also have showed the effects of soft tracking on students growth mindset. Unfortunately, permission from 4th and 5th grade teachers was not received. These grades were not able to be surveyed.

The data analysis showed a significant decrease in students' growth mindset from 6th to 8th grade, but it cannot be said that tracking was the sole cause of this change. There are many other variables that could have influenced the students' mindset scores. The 6th grade students were from an elementary school while the 7th and 8th grade students were from a junior high. The change in the type of school or the school culture could affect students' mindset score. The elementary school could have a focus on learning and growth while a junior high might have a stronger focus on results and grades. Further research might be able to remove this variable by conducting research in a 6th through 8th grade middle school or a kindergarten through 8th grade school. This would ensure that the culture of the school would remain the same for each grade level.

Another factor could be the age of the students. Younger students might view math as more exciting and as a challenge while older students might view math as a subject where the correct answer matters more than the learning process. A way to negate this influence could be to compare the growth mindset of students from schools where students are tracked and schools where students are not tracked. This would show if the age of the students is impacting their mathematical mindset or if the influence is from being tracked.

A final factor that was not accounted for in this study that could influence a students' mathematical mindset is the math teacher the students have. Teachers, knowingly or unknowingly, communicate growth or fixed mindset messages to students every day. When conducting the surveys, it was noticed that several of the classrooms, from all grade levels, had growth mindset posters or messages hung in the room. Some of the teachers or the schools could be explicitly teaching growth mindset ideas which would influence students' growth mindset, too. Further studies should collect data on whether growth mindset ideas have been promoted to students before.

A continuation of this research could be to continue the survey into 9th through 12th grade. Figure 2 shows a clear downward trend in the number of students holding growth mindsets and an increasing amount of students in the upper grades holding mixed and fixed mindsets. It would be interesting to see if this trend continues through the high school grades.

Conclusion

Students are holding fixed mindsets in math more than any other subject. There are many disadvantages associated with fixed mindsets and it is important to encourage growth mindsets in students. Tracking is more common in math than any other subject and sends fixed mindset messages to students however, no research had been done that analyzed the relationship between tracking and students' mathematical mindsets. This study was meant to fill that gap and the results indicated that there is a relationship between tracking and fixed mindsets in students.

More information is needed to truly understand the implications of tracking in math on students' growth mindsets. There are many possible factors that could have affected the students' scores such as the type of school, the age of the students, and the mindset messages communicated to students by their specific teacher and school. These limitations could be resolved by conducting this study in a 6th through 8th middle school building, comparing the mindsets of tracked and untracked students of the same grade level, and collecting data on mindset interventions that the teachers and schools had already performed. These recommendations would make the relationship between tracking and mindset clearer.

Even with the limitations, these results do show that tracking's influence on students' mathematical mindsets is an area of interest that should be researched more. A growth mindset in mathematics should be encouraged in all students and the results of this study show that tracking could be negatively affecting students' growth mindsets in math. There are many criticisms of tracking and the harm to a student's mathematical mindset could be an additional one. Those involved in education need to be critical of tracking and the harm it could be causing to students.

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Appendix A: Survey

Please circle the answer that best fits how much you agree with the statement. There are no right or wrong answers. Select the one that best fits with what you believe.

1. You have a certain amount of math smarts, and you can't really do much to change it.

Strongly Agree Agree Neutral Disagree Strongly Disagree

2. There are limits to how much a person can change their basic math ability.

Strongly Agree Agree Neutral Disagree Strongly Disagree

3. You can learn new things, but you can't really change your basic math smarts.

Strongly Agree Agree Neutral Disagree Strongly Disagree

4. No matter who you are, you can improve your math smarts.

Strongly Agree Agree Neutral Disagree Strongly Disagree

5. You can learn new things, but you can't really change how smart in math you are.

Strongly Agree Agree Neutral Disagree Strongly Disagree

6. Only some people will be truly good at math- you have to be "born with it."

Strongly Agree Agree Neutral Disagree Strongly Disagree

7. You can always change how smart you are in math.

Strongly Agree Agree Neutral Disagree Strongly Disagree

8. Your math smarts is something very basic about you and it can't change much.

Strongly Agree Agree Neutral Disagree Strongly Disagree

9. Truly smart math people do not need to try hard in math.

Strongly Agree Agree Neutral Disagree Strongly Disagree

10. The harder you work at math, the better you will be at it.

Strongly Agree Agree Neutral Disagree Strongly Disagree

11. I like work that I'll learn from even if I make a lot of mistakes.

Strongly Agree Agree Neutral Disagree Strongly Disagree

12. I like my work best when I can do it perfectly without any mistakes.

Strongly Agree Agree Neutral Disagree Strongly Disagree

13. To tell the truth, when I work hard in math, it makes me feel as though I'm not very smart.

Strongly Agree Agree Neutral Disagree Strongly Disagree

14. When something is hard, it just makes me want to work more on it, not less.

Strongly Agree Agree Neutral Disagree Strongly Disagree

*Questions 4, 7, 10, 11, and 14 are reverse scored.