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Student Success in Virtual Versus In-Person Learning During a Direct Instruction Math Intervention Course

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Abstract

Public education has always been thought of as being completed in a brick and mortar setting with students in desks and teachers at the front of the classroom. Students interact with their peers and learn through lecture and hands-on activities. This general understanding was quickly changed in the spring of 2020 due to the Covid-19 pandemic. Schools had to shift from in person learning to online learning with little to no planning time. As schools began to transition back in the fall of 2020, school boards had to make the choice of continuing all virtual learning, creating a hybrid learning schedule, or transitioning to full in person learning. Several school districts throughout the country established a hybrid learning schedule with the option of full virtual learning for students that have an increased susceptibility to Covid-19. This led to the question of validity with virtual learning versus hybrid learning. There is limited research surrounding virtual learning in K-12 schools, but the literature surrounding virtual learning in post-secondary settings has shown positive outcomes for students. The ability to determine the effectiveness of targeted math instruction for students attending a direct instruction class twice a week during the Covid-19 pandemic has led to the development of this capstone project.

Virtual Versus In-Person Learning

Introduction

In person learning is the norm around the world amongst all grade levels and institutions. When people think of school, they think of a large building, with multiple classrooms that are filled with students, teachers, desks, and materials. With the global outbreak of Covid-19, the typical idea of school had to shift to keep students, teachers, and school staff safe. This shift

resulted in the use of virtual learning. This paper explores the use of virtual learning compared to in-person learning. Are there compatible ways to teach or learn content for those in K-12 institutions? The majority of research on virtual versus in-person learning has been done in the collegiate setting with findings generalized to fit a K-12 model.

Review of Literature

Virtual Learning

Online learning is a growing platform for education. The Sloan Foundation annual report in 2011 stated that over 6.5 million students were enrolled in at least one online postsecondary course (Kauffman, 2015). Virtual learning is described as students and teachers separated by time, location, or both. It can be synchronous, or real-time classes with a teacher leading instruction while the students attend online, or asynchronous, where the student and teacher interactions are delayed and usually through email or another messaging system (McFarlane, 2011). Thinking about the state of the world in 2020, the number of students completing their schooling online will be much higher because most schools have chosen to utilize online learning to protect the safety and health of staff and students in education. According to The Sloan Consortium's 2011, 51% of college level deans or academic administration believe virtual learning is equivalent to face-to-face learning, while 14% believed it was superior (Kauffman, 2015).

Online Learners

Online learning can support all individuals because of the flexibility and convenience that are not typical of a face-to-face course. However, a successful online learner needs to be self-motivated, self-directed, have an internal locus of control, have communication skills, and

technological skills (Kauffman, 2015). Some research has indicated that online learners performed better on their assessments than those completing the course face-to-face. They did note that this difference in scores could be related to the availability of notes during the assessment time. Online students may have notes open because the teacher is not there to monitor the students in-person (Kauffman, 2015).

Virtual Learning Environments

Virtual learning environments (VLEs) are another product that can be used by teachers to create a class with enrichment and hands on learning even when students are online. VLEs are simulations using 3D technology with digital avatars to provide real-life scenarios. They can also provide individualized platforms that meet the learning needs of each student. VLEs can be used for students with social skill deficits. VLEs provide a safe space for students to practice their social skills in a structured, comfortable environment (Vasquez, Nagendran, Welch, Marino, Hughes, Koch, Delio, 2015). Vasquez et al., shared that VLEs are important tools that can be used to support students in special education that need social skills practice. VLEs can also be used during these unprecedented times. While students are at home, they have the ability to complete labs for science or explore historical events in a 3D simulation (Vasquez et al. 2015). VLEs provide enrichment that a normal textbook or lecture format would not allow.

Course Design

Instructional design of online courses are main factors of learning outcomes and student satisfaction. Kauffman (2105) shared findings from a qualitative research study that compared multiple approaches to the instructional design of an online course. The first design is a constructivist-based design. This type of design is structured around the learners being actively

involved in their learning. A constructivist-based design course included peer-moderated discussions, group projects, and online chat room meetings (Kauffman, 2015). The next design model was the integrated design model. In this model, content was unstructured. There were no assigned textbook readings but there was online discussions and projects that were facilitated by the instructor (Kauffman, 2015). The next design model is the content-support model. This model is very structured with pre-recorded lectures, assignments, quizzes, and minimal interaction amongst students. Finally, there is a wraparound design model. This model is a combination of integrated and content-support. Approximately 50% of the course is dedicated to discussion that is somewhat structured, and the other 50% is focused on virtual lessons each week that have corresponding assignments (Kauffman, 2015). Research suggested that students were most satisfied in a course that utilized the integrated design model because they were able to explore the content and become more engaged with their classmates. Kauffman (2015) stated that researchers found that students performed best when they were allowed to participate in coursework that allowed for reflection and problem solving (Kauffman, 2015). Kear, Chetwynd, & Jefferis (2014) shared that participants of online courses responded best when students were able to include their personality in the learning community through discussions or projects. This inclusion allowed students to be seen as ‘real people’ by their classmates (Kear, Chetwynd, & Jefferis, 2014).

There are some negative viewpoints surrounding online classes which can lead to negative learning outcomes including motivation and persistence. Online learning does not allow for nonverbal check ins and clarification. Students must utilize writing, whether that is through assignments or email, to communicate their misunderstandings and ask for support (Kauffman, 2015). Kauffman (2015) stated that students can reach a level of frustration at a quicker rate due

to the absence of immediate feedback when completing online coursework. A level of frustration can also be reached because of poorly designed or organized courses, creating another barrier towards learning the course material (Kauffman, 2015). Online learning can also become an impersonal form of learning. There is a lack of personal communication within an online course and because of this, key nonverbal cues are missed, such as facial expressions and body language (Kear et al., 2014). Kear et al. (2014) discuss the need for social presence amongst students online. A lack of social presence can lead to low levels of engagements for students.

Virtual Versus In-Person

In-person learning is what people typically think of when they think of public education. Face-to-face allows direct and immediate interactions between the teacher and students. This allows teachers to complete verbal and nonverbal checks for understanding and quickly adapt lessons to support learner's needs (Kauffman, 2015). Teachers can answer questions as they come up and can provide clarifications to prevent misunderstandings of the course materials. In-person schools and materials are available to students throughout a school day, while virtual schools are available 24/7 to allow for flexibility and individually paced work completion (McFarlane, 2011). Although the students attending a virtual school have flexibility and can work at their own pace, they may feel isolated. These students lose the social benefits of an in-person school. Virtual students are not able to interact with their peers at the same level as in-person students. At home distractions, such as television, eating, video games, etc. are other issues that can arise for virtual students that in-person students do not have to deal with (McFarlane, 2011). In-person students are in the classroom and teachers do their best to limit these outside distractions so that their students can complete the course material in a reasonable manner. In-person schools teach students how to better function in adult society. They provide

practice in how to appropriately create friendships and maneuver encounters with other individuals (McFarlane, 2011).

Either way, virtual and in-person learning must prepare students for the workplace and the real world. Virtual learners can have access to many outside resources that students completing in-person learning may not have available to them. This includes networks outside of their community that they can connect and learn from. In-person students are often introduced to those in their community because they are easily accessible (McFarlane, 2011). This difference in outreach and networking possibility allows virtual students the ability to expand their opportunities for post-secondary schooling and job opportunities. Students in a virtual learning environment also become more versed in the use of technology because they are utilizing it every day. Technological literacy is an important skill to obtain to enter the workforce in today's society (McFarlane, 2011).

Virtual learning has been an option for post-secondary education for many years. With the onset of Covid-19 virtual and hybrid learning has been used widely across the globe to support social distancing measures in all school settings. In person learning is the most ideal for students in public school systems, but virtual learning is an appropriate solution when deemed necessary. Math is one curriculum area that may be difficult to teach virtually to students within special education because of the increased need of direct support.

Evidence Based Practices for Teaching Math

Best Practices for Teaching Students with a Math Disability

Students in middle school with a learning disability often learn best when provided interventions outside of the core if they are just below grade level. Students with a math

disability that are much farther below grade level benefit from an alternative curriculum at their education level. Alternative curriculums should utilize the following strategies to support learners: explicit instruction, use of manipulatives, utilizing visuals, schema-based instruction, drill and practice, and cognitive and metacognitive strategies for solving word problems (Greene, 2020).

Explicit instruction is utilizing teaching models that create a completely clear learning process for students. Teachers first model a skill and verbalize their thinking process, using clear and concise language while completing the skill (Greene, 2020). Students are then given opportunities to complete guided and independent practice while the teacher provides feedback. Practice should include any new skills and review skills learned previously and should be scaffolded based on the learner's needs and understanding (Greene, 2020). Scaffolded instruction is based on student feedback. Teachers should support as much as necessary for success and then remove support as the student shows understanding (Greene, 2020). Explicit instruction is the basis for the concrete representational abstract framework (CRA). This framework is widely used when teaching math. It combines explicit instruction with two other evidence-based practices, use of manipulatives and use of visuals (Greene, 2020).

Manipulatives are a hands-on component that allows students to become active participants in constructing knowledge and understanding (Agrawal & Morin, 2016). Research indicates the use of manipulatives helps students be more engaged and motivated in their learning (Agrawal & Morin, 2016). Manipulatives can help students create a concrete representation or a hands-on component of the problem being solved. Students are able to share their thinking and reflect on their learning more clearly (Agrawal & Morin, 2016). Common manipulatives include Base-10 blocks, counters, algebra tiles, and geoboards.

Visual representations allow students to see the math problem. This removes the language barrier that may be present for those struggling in math (Greene, 2020). Visuals can bridge the gap between manipulatives and abstract mathematical concepts (Agrawal & Morin, 2016). Visuals can be pictures of manipulatives, virtual manipulatives, 100s charts, number lines, or graphic organizers. Virtual manipulatives can include drawing apps that students can draw out their problem or apps that provide the manipulatives on the screen. Common virtual applications for manipulatives include Base-10 blocks, money, clocks, number lines, and others. Pictorial representations of problems should help students understand the relationships between facts and concepts, which in turn should help them organize and solve the problem at hand (Agrawal & Morin, 2016).

Visuals should be paired with schema-based instruction to support students solving word problems. Schema-based instruction teaches students how to determine word problem types, so they have an easier time creating a solvable equation (Greene, 2020). Teachers must teach students to find patterns within a word problem. The two types of schemas are additive and multiplicative (Greene, 2020). Additive problems include addition and subtraction problems, and multiplicative includes multiplication and addition problems. Students are taught to pick out math words that define the type of problem that will be used to solve the problem. (Greene, 2020). According to Agrawal and Morin (2016), teaching students to solve word problems should be embedded in the other lessons, not its own lesson. They stated this helps with generalizing the math concepts that are being taught (Agrawal & Morin, 2016).

Finally, cognitive and metacognitive strategies can also be used for supporting learners completing word problems. Miller and Hudson (2007) shared an example of steps that can be used for completing a cognitive approach to word problems. This approach asked students to use

five steps for completing the problems (Miller & Hudson, 2007). The steps are read the problem aloud, look for important words and circle them, draw pictures to tell what is happening, write down the math sentence, and write down the answer. Instruction towards the cognitive process should include pre-skill development, conferencing, strategy discussion, modeling, mastery of the sequence of steps, guided practice, independent practice, and generalization (Miller & Hudson, 2007).

Connecting Math Concepts

Defined

Connecting Math Concepts is a direct instruction program created to support learners that struggle with math. A direct instruction model is used as an alternative to core mathematical curriculum. The model's philosophy is: "All students can learn if both the instructional material and the teacher's presentation are clear and unambiguous" (Laurrell-Klotz, 1999). The Connecting Math Concepts curriculum is used for students performing well below grade level. It focuses on the main concepts of math by using explicit instruction to support the mastery of difficult concepts such as ratios, proportions, probability, functions, and data analysis (McGraw). Teaching is completed in a whole or small group manner through the use of detailed explanations and guided practice to help students move towards independent work. This program hopes to help students become more confident and successful mathematical thinkers (McGraw).

The creators of Connecting Math Concepts present a detailed approach to understanding the basic concepts of mathematics, how these concepts connect, and how to build problem-solving strategies. Connecting math concepts should push students to be mathematical thinkers and communicators (McGraw). These skills and strategies are learned through use. Concepts are presented incrementally and extend into subsequent lessons to continue practice of all skills.

Multiple skills are taught and applied throughout each lesson. McGraw Hill publishing states, “Students learn in less time, remember more, and develop a depth of understanding needed for advanced mathematics” (McGraw).

Classroom Structure and Implementation

Direct instruction models utilize sequenced lessons that build on previous learned skills. Teachers support learners as they develop a hierarchy of complex mathematical problem solving (Laurrell-Klotz, 1999). Teachers using a direct instruction model must take into count two major points. Teaching time needs to be increased to allow for adequate time to reach desired academic outcomes. Teachers should set aside at least thirty minutes of small group instruction each day (Laurell-Klotz, 1999). Teaching efficiently is the second point that needs to be considered. Efficient teaching can be achieved by using scripted lessons, small-group instruction, positive reinforcement, and corrections. Scripted lessons provide precise wording teachers should use as well as examples on implementation and sequences of skills (Laurrell-Klotz, 1999).

Connecting Math Concepts is taught through fully scripted lessons. Lessons present information in a controlled rate that allows for a continuous review of materials. Each lesson corresponds with workbook pages that provide modeled and independent practice for students (McGraw). There are six levels to Connecting Math Concepts. Each level contains 120 lessons that should take one school year to complete (Laurrell-Klotz, 1999). Skills are organized in tracks with three to five tracks being presented in each lesson. According to Laurrell-Klotz, “A track is an ongoing development of a mathematical concept” (Laurell-Klotz, 1999). Connecting Math Concepts organization allows students to achieve mastery of a wide range of mathematical concepts without becoming overwhelmed by new information.

AVMR

Defined

AVMR stands for Add+Vantage Math Recovery. This program was created by the US Math Recovery Council in 2003 as an option for general education, special education, and intervention teachers to use within their classrooms to teach mathematical concepts and skills to promote advancement in mathematical thinking (Miller, Wright, Stafford, Tabor, 2014). This intervention is promoted for one-on-one intervention times with 4 – 11-year-olds. The program's overarching goal is, "To provide a robust intervention framework for teachers working with elementary students to help in the construction of numeracy skills, through assessment, which incorporates a strong analysis component and individualized teaching (Miller, et al., 2014)."

Classroom Structure and Implementation

AVMR utilizes a structured assessment system to identify struggling students. AVMR has created four separate assessments that identify the level a student is performing at and the next steps for educators. Assessment 1.1 focuses on the child's ability to add and subtract, their knowledge of number words and number word sequences both forward and backward, their ability to name numerals, and their ability to sequence numerals. Assessment 2.1 assesses the student's ability to combine and partition numbers to 10, assign a number to spatial patterns when flashed briefly, and finger patterns or base-five strategies (Miller et al., 2014). Assessment 1.2 determines a student's knowledge of the tens and one's structure of the numeration system, and their range of strategies for solving addition and subtraction tasks other than counting-by-ones. Finally, assessment 2.2 assesses student's abilities to combine and partition numbers to 20, their understanding of part-while construction of numbers, and their ability to use mental

computation skills when solving new mathematical tasks (Miller et al., 2014). Teachers also observe students as sessions are completed as an informal assessment so they can adjust and rearrange their teaching patterns to support the learner's needs.

Students that are identified as struggling participate in a 12 to 15-week teaching cycle. They work one-on-one for 30 minutes a day, five days a week (Miller, et al., 2014). Teaching is organized in a progression of three strands: number words and numerals, counting, and grouping. Teachers should choose the starting point based on assessment results for each student they are working with and adjust based on each session outcome (Miller, et al., 2014).

Data Collection and Comparisons

Issues Due to Virtual Learning

Teaching simultaneously to in-person students and virtual students is difficult. These difficulties included camera problems, PowerPoint issues, microphone issues, as well as distractions. Students in the virtual program joined during the class period through Microsoft Teams. Lessons were shown through screen share on Microsoft Teams. At the beginning of the first synchronous lesson, it was discovered that the teacher iPad did not allow for screen sharing on Teams at the same time as projecting. This had to be fixed by using the iPad for projecting and connecting to the Teams call through the computer. Having to use two different devices at once limited the mobility that should have been available using an iPad. The use of screen sharing also limited the view of students. They were unable to see anything but the PowerPoint and because of this they were unable to view examples being written on the board. This led to the usage of the Microsoft Whiteboard application. This application was touch sensitive and would glitch, creating issues for the students on Microsoft Teams. Microsoft Teams would also

mute users randomly while using the Whiteboard application. It would not provide an alert if the user was muted, and because of this a lesson would continue and students would miss parts of the explanation or the teacher would continue without knowing students had questions. Finally, virtual students had to deal with distractions and internet issues at home. Virtual students were late to meetings because they would lose track of time or be doing other things. Internet speed also played a factor during lessons. There were times in the middle of a lesson a student would seem to have signed out of Microsoft Teams, but they would join and state that they were kicked out of the meeting. After talking with the technology team, it was determined that if the internet lagged or was slow Microsoft Teams would be affected.

Evidence Based Practices Utilized

Evidence based practices are teaching strategies that have been shown to support all learners and create an environment that promotes learning for all learning styles. Evidence based practices are always used within a direct instruction program, like Connecting Math Concepts. Explicit instruction is the main strategy utilized in the classroom. Connecting Math Concepts is a structured curriculum that provides a clear progression when teaching skills. It also provides fully scripted lessons that the teacher follows. This means that directions and instruction are given in a clear and concise manner and prevents the use of confusing language or structure.

Manipulatives and visuals are used to support student learning with Connecting Math Concepts. Due to the Covid-19 pandemic, manipulatives in the classroom have had to be adjusted. Within the Connecting Math Concepts classroom in the fall of 2020, students are utilizing applications on their iPads. These applications include a number line app, a number rack app, number pieces which are base-10 blocks, and money pieces. Other applications are available, but these are the ones that are used most often to support the students within a small

group intervention class. Visuals have also become a core part of teaching students with skill deficits because they provide a picture for students. Students can use the pictures to support their understanding of the problems being solved.

Finally, drill and practice are utilized within the Connecting Math Concepts curriculum during every lesson. Lessons are structured as a progression with a review of tasks previously learned. These tasks include adding and subtracting with number families, skip counting, and simple multiplication. The number families are reviewed every day to support student understanding that students can use adding problems to support subtraction and vice versa. Skip counting is also practiced regularly to support the understanding of multiplication and regrouping. Students are able to practice their previously learned skills continuously so that the information is cemented in their long-term knowledge.

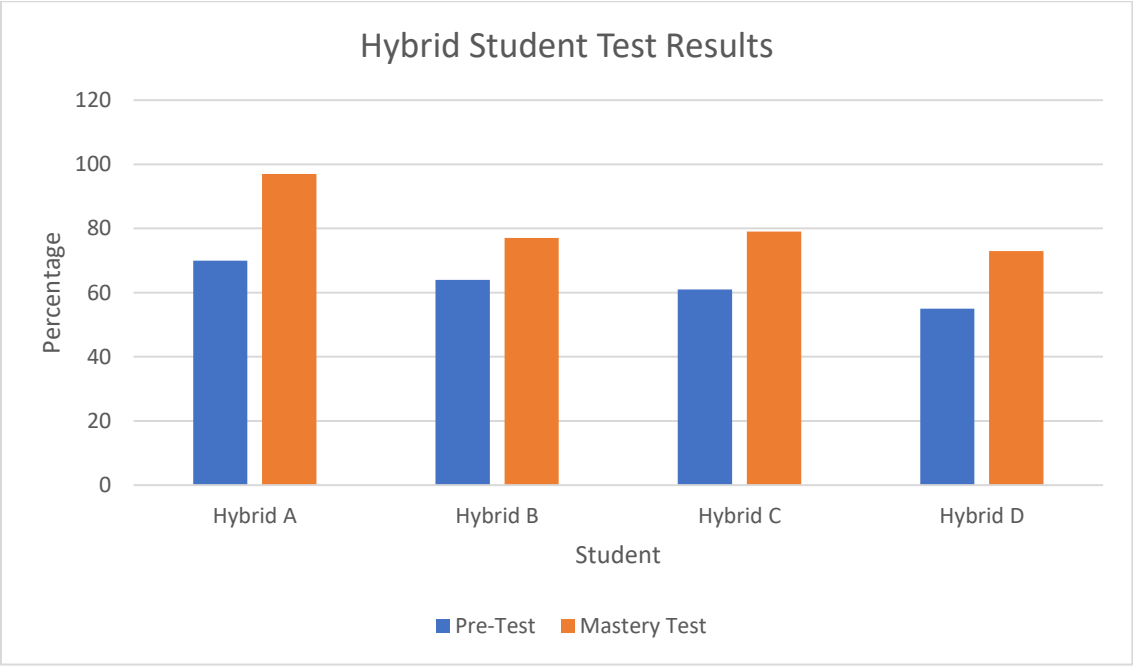
Discussion of Research

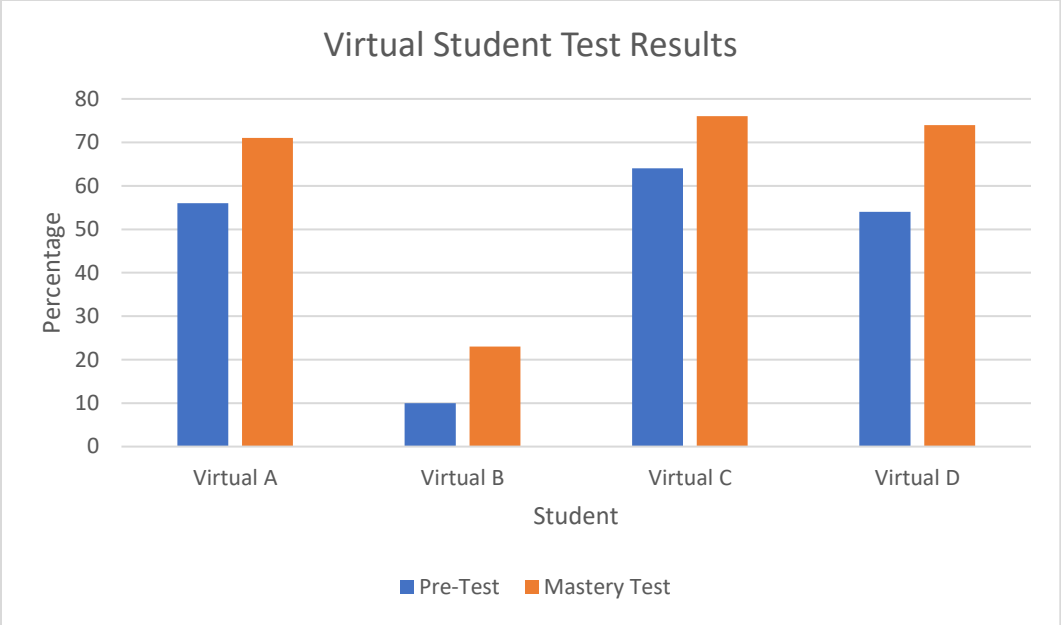
Students participated in a direct instruction math intervention program. Due to the Covid-19 pandemic, students participated in hybrid learning twice a week or participated in virtual learning. There were four students that participated in hybrid learning. Hybrid learning occurred in school twice a week with extra practice being sent home as necessary. Four students participated through the virtual program and connected twice a week through Microsoft Teams. Synchronous occurred twice a week for each group and asynchronous learning was completed the other three days of the week.

Lessons followed the direct instruction program, Connecting Math Concepts. This program is designed to complete two lessons a week, but due to hybrid and virtual learning only

one lesson was completed each week. Students are unable to complete lessons on their own, so lessons had to be completed during synchronous learning.

Students completed a pretest at the beginning of the year to determine their prior knowledge and to create baseline for learning growth. After ten lessons were completed, students were evaluated through a mastery test. The following graphs compare student outcomes on each test and the growth each student made.





As seen in the graphs above, hybrid students averaged higher scores on both assessments. On the pre-test hybrid students averaged a score of 63% correct. Virtual students averaged a score of 46% on the pre-test. Hybrid students averaged a score of 82% on the mastery test. This average is brought up due to Hybrid A scoring a 97% on the test. Virtual students averaged a score of 61% on the mastery test. Hybrid students' average percentile growth was larger than the virtual students. Virtual students had an average of 15 percentile points growth, while the hybrid learners averaged 19 percentile points in growth. Virtual B is an outlier that affects the average percentile growth and scores for the virtual students because their scores on both assessments are much lower than their peers.

Reflection on Research

Based on the data collected hybrid students outperformed the virtual students, but due to the small number of participants and limited data, it is difficult to make definite conclusions. Virtual learning for student involved in a direct instruction learning program is difficult. Based on my experiences with teaching intervention students, in person learning provides clear benefits

in their growth and gap closures more than virtual learning. I understand that some students do not have the option to come to school due to health issues within their home, but I do think that they would learn more in person. With my hybrid students I was able to check problems and answer questions immediately, but I was not able to do quick checks with virtual learners, because I could not see their work as they were completing it. Hybrid students also had limited distractions. They were seated facing the board, and I was able to walk around and ensure they were on task. Virtual learners had the distraction of being home and having more preferred activities around them. Overall, I do believe that in person learning is more beneficial for students involved in a direct instruction intervention program, but more research needs to be completed to find a more accurate determination.

Conclusion

Fort the past several decades, post-secondary schools have used virtual learning as a flexible option learning option for their students. Research behind virtual learning in post-secondary settings has shown that students perform similarly or better than their peers, because of the resources available to them. There has been limited research on virtual learning in K-12 schools, because until recently this learning option has not been used. In the spring of 2020, Covid-19 caused a drastic switch to virtual learning across much of the country. Virtual learning continued into the fall of 2020. This unknown led to my comparison between virtual and in person learning. The data collected found that hybrid learners performed at a higher percentage than their virtual peers, but this research is limited due to class size and lack of testing. Research is also limited because it was completed in an intervention math course and results may differ within a general education classroom. If virtual learning is to continue in K-12 settings, more research must be completed.

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