

# Learning Impact among Preschoolers with Down Syndrome in Virtual and Physical Setting - A Comparative Study

Kanza Abbasi, Bushra Amin, Ayesha Zuberi, Amar Latif Qazi, Saira Ibrahim, Sadia Saleem  
Karachi Down Syndrome Program (KDSP)  
Pakistan

## Abstract

*The COVID-19 pandemic necessitated a shift in teaching practices from physical to virtual spaces. The Early Pre-School Experience Program (EPEP) by the Karachi Down Syndrome Program (KDSP) is a one-year preschool for children with Down syndrome between the ages of 1.5 - 2.5 that teaches basic functioning skills across six areas of academic intervention; Communication and Language, Fine Motor and Gross Motor Skills, Cognition and Play, Social and Emotional Development, and Self-help Skills. This case study compares the difference in learning outcomes for preschoolers in these six areas between physical and virtual classes. The percentage increase in learning was measured through pre-test and post-test evaluations of Student Learning Outcomes (SLOs) achieved in the physical batch of 2019 and the virtual batch of 2020, where 13 students were enrolled in each. The comparison of results between both batches indicated that SLOs in virtual classes increased by 11% points, as compared to the 46% point increase in the physical space. The findings reflected that the academic learning outcomes of preschoolers with Down syndrome depend on their ability to focus, respond to and follow instructions in class. Virtual classes made the monitoring of these variables challenging, and limited the social experience of learning, which is essential for a child's development. Hence, it was concluded that physical classes are more effective for achieving their learning goals. Furthermore, findings indicated increased parental involvement in the virtual space, where ease of access to learning and teaching methodologies positively impacted learning outcomes of children with Down syndrome.*

## 1. Introduction

In this paper we analyse the consequences of the pandemic on Early Pre-School Experience Program (EPEP) launched in 2017 by Karachi Down Syndrome Program (KDSP) for children with Down syndrome between the ages of 1.5 - 2.5 years. EPEP is a one-year program that helps children with Down syndrome learn basic functioning skills that include six distinct areas of academic intervention:

- Communication and Language
- Fine Motor Skills

- Gross Motor Skills
- Cognition and Play
- Social and Emotional Development
- Self-help Skills

The main objective of the program is to prepare the children for a confident transition and settlement in inclusive mainstream schools. The following study is a comparison of learning in virtual setting vs. physical setting in terms of Student Learning Outcomes (SLOs) achieved for students. The pre-test and post-test results of both years, 2019 and 2020, will also be presented for a clearer understanding of areas that were affected most and least during the virtual conduct. Since preschool years are the most formative years of a child's life, the Early Pre-School Experience Program (EPEP) encapsulates all modes of learning including one-on-one station time, small group and big group sessions that facilitate both individual learning and social development for all enrolled children with Down syndrome. The sessions are structured such that all areas of academic intervention are inculcated and taught on a regular day-to-day basis with each session lasting for approximately 120 minutes per day, five days a week. Additionally, for children with Down syndrome, continuing to reinforce all concepts introduced in sessions is extremely critical, hence, for that purpose, weekly home plans are created and shared with parents to reinforce the taught concepts at home.

## 2. Literature Review

The EPEP model was originally adapted from the Rise school model based in Houston, Texas, USA. The Rise school was originally set up to provide an inclusive preschool environment to children with disabilities, so they can successfully transition to mainstream environments. This school caters to children between the ages of 6 months to 6 years with and without disabilities [1]. The effectiveness of early intervention for children with Down syndrome has also been studied and research suggests that early education programs facilitate better learning and development for children with Down syndrome across most areas of intervention [2].

Preschools offer a nurturing environment for children, replicating it online is beyond the capacity of educators and early childhood ideologues. Teachers adopt a hands-on approach to interact with preschoolers. Four ways of engaging with children are identified in preschool environments by Timmons et al. [3]. These include building relationships with children; enabling the curiosity of children through their environment and surroundings; focusing on the child's emotional and physical wellbeing; and providing a platform for children for self-expression. This is difficult to practice and execute virtually.

Timmons et al. [3] assert that in virtual conduct, disparities exist between teachers and parents in terms of accessibility to internet connectivity and relevant resources. Class teachers have a pool of resources that most parents do not. A parent according to this study reports issues with time consumption and stress when it comes to online classes with multiple children in the house. To address the unavailability of resources, a teacher recommended a resource pack for parents, though that was only suggested and not implemented. Their approach was to make learning device-free and not dependent on technology. In addition, the teachers reported on was their concern for homes that lack social support and a safe environment for children. They assert that such children need the classroom environment the most. Parents expressed doubts over their inability to be able to teach the child using the proper strategies to support their academic learning. Even the methods of teaching which the parents adopted failed to be consistent. Moreover, there are disparities found between parents who have better support at home. There are certain determinants that are pertinent for the achievement of goals in a preschool environment as identified by Kirk and Jay [4]. These include the immediate classroom environment, play and relationships built between teacher and child, and between a child and his peers. The environment fosters connections difficult to build in online setups. This is backed up by Halle and Darling-Churchill [5] who discuss how physical interventions affect a child's future well-being and achievement.

Smith et al. [6] reveal that parents prefer online classes for their children with special needs, despite the significant differences between physical vs. virtual school environments. This is due to their dissatisfaction with conventional schools in general. In a virtual classroom, the author emphasizes the significance of communication between parents and teachers.

Parents are often the closest resource for children to seek help and comfort from during prolonged isolation, and it offers a good opportunity to improve the interaction between parents and children [7]. It has been proposed that online schooling system with parental support guidelines can help strengthen the relationship between parents and their children [8].

Parents take on the role of teacher, and it results in an increased parent-teacher communication along with greater time commitments regarding their child's learning [6]. Online classes, therefore, have the potential to solve the issues of lack of parental involvement in IEPs by implementing the suggestion which advocates communication, relationships and collaborative planning between schools and parents in order to build a foundation for student-centered educational plans [9].

It has been noted from literature review that increased communication and parent participation as gateways to positive outcomes for students with disabilities [10,11]. Therefore, moving to a virtual model and comparing it with the physical one can serve as an opportunity to evaluate different approaches and could also help develop a hybrid model of teaching and learning suited to specific educational needs [8].

### 3. Case Study: Physical to Virtual Transition

Our physical structure learning was disrupted with the outbreak of COVID-19 in Pakistan in March 2020 followed by the government's decision to close down all schools across the country to prevent the spread of the virus. Whilst the pandemic has brought unprecedented challenges both for the organization and its beneficiaries, Karachi Down Syndrome Program developed strategies in response that ensure the educational development of children with Down syndrome was not compromised. Hence, the Early Pre-School Experience Program (EPEP) moved children from the traditional classroom setting to a virtual setup that exclusively involved digital teaching, and learning at home to maintain continuity and give parents and caregivers access to remote education resources and support during the pandemic lockdown.

The physical class structure of EPEP in August 2019 included a two hours long group session which had one-on-one station time dedicated to each area of academic intervention for all children. Station time included four stations: Communication and Language; Cognition and Play; Fine Motor (including self-help skills); Gross Motor. Socio-emotional skills were worked on in small group and whole class activities while the rest of the areas were promoted through the addition of individual stations conducted by every teacher. The teacher-student ratio was 1:3. Activities for the development of gross motor skills were conducted outside the classroom, in the play area by a Physical Therapist (PT).

The new class structure of EPEP in August 2020 was re-designed as a user-friendly digital platform for the new batch of 2020, along with other modifications including elimination of one-on-one station time and equal allocation of students amongst the facilitators.

Moreover, to address the concerns of short attention span and low sitting tolerance in children with Down syndrome, the duration of the online zoom session was reduced to 30 minutes per day, five days a week, incorporating both small and big group activities. The area of Gross Motor was recorded by every child’s respective PT. Resource packs containing relevant educational items, needed for class activities and evidence based home assignment submissions, were also provided to parents to facilitate a smooth virtual learning experience for their children.

#### 4. Results

Our research study shows a comparison between the academic semesters August - December 2019 and August - December 2020. A pre and post-test analysis is conducted each year to measure the students’ progress and impact in learning in both types of classroom format. There was a significant difference between the pre and post-test of results of the physical class structure, Aug - Dec 2019 and the pre and post-test result of the virtual class structure, August - December 2020 (see Figure 1).

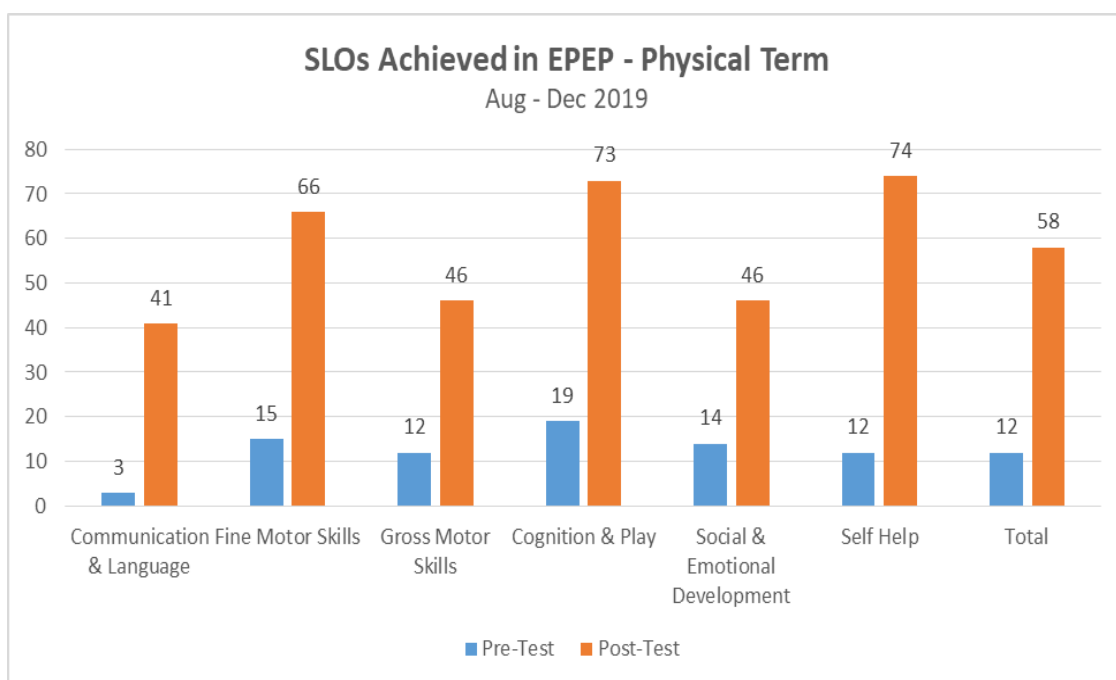


Figure 1. Pre-test and post-test results of SLOs achieved in EPEP during physical classes between August and December 2019

The average percentage of SLOs achieved in the pre-test in physical classes (August 2019) when the children were enrolled was 12%, whereas the percentage of SLOs achieved at the end of the first semester in the post-test in December 2019 was 58%, indicating an increase of 46 percentage points in learning. The area of highest recorded progress in the physical class format was Self-help with an increase of 62 percentage points in learning, while the area of lowest recorded progress was Social and Emotional Development with 32 percentage points increase in SLOs achieved at the end of the first term.

Comparatively, the total overall percentage of SLOs achieved in the year of virtual class set-up was considerably lower than the previous year’s physical

class set-up (see Figure 2). The average percentage of SLOs achieved in the pre-test in August 2020 when the children were enrolled was 10%, whereas the percentage of SLOs achieved at the end of the first semester in the post-test in December 2020 was 21%. This indicates a rise of 11 percentage points, which is substantially lower than the 46 percentage point increase in learning in 2019. The area of highest recorded progress in the online class format was Communication and Language, as it rose by 21.4 percentage points between the pre-test and post-test. While the academic area with lowest recorded progress, Gross Motor Skills, recorded only an increase of 2 percentage points in learning at the end of the first term.

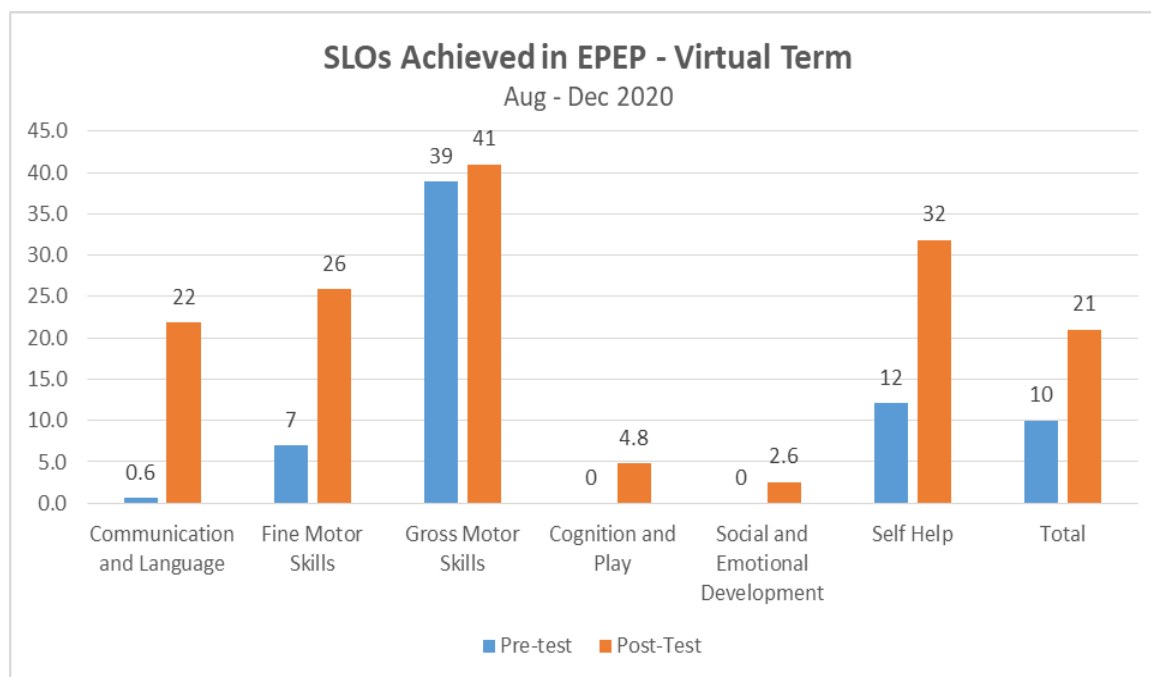


Figure 2. Pre-test and post-test results of SLOs achieved in EPEP during virtual classes between August and December 2020

To check for the statistical significance in learning impact between pre-test and post-test results a paired t-test was computed for each dimension in each batch (see Table 1). Our t-test shows that there was a statistically significant improvement in all dimensions across the physical batch. While the improvement in the virtual batch was only statistically significant in the dimensions of: Communication and language; Fine Motor Skills; and Self Help. However, the improvement in overall SLOs achieved was statistically significant in the virtual batch as well. Overall, even though the results in the virtual batch were not as significant as in the physical batch, the outcomes were favorable with no sign of regress, both socio-emotionally and academically.

The Figure 2 displays the difference in learning for students in physical classes, and virtual classes. As indicated in the graph, the mid-year evaluation of students' academic progress shows a massive difference between percentage increase in learning between physical in-person and online virtual classes. In all areas of academic intervention, in-person classes yielded far better results than the virtual set-up. The highest difference between physical and virtual class format was determined in the fourth area of academic intervention, Cognition and Play, with a difference of 49.2 percentage points in learning impact. Another area of academic intervention that had considerably delayed progress in virtual sessions

as compared to physical sessions was Self-help with a reduction of 42 percentage points in learning impact. One of the reasons that can be identified for this substantial decrease in learning outcomes achieved is the lack of hands-on involvement from the teachers in virtual space. These two areas of academic intervention require active participation and interaction between students and teachers which was limited in the online class format. In the physical setting, 8-10 minutes were allocated per child at every station compared to the virtual setting which involved 15 minutes to cover all areas. The absence of repetition of activities can also be a reason why there has been a substantial decrease in all areas.

The areas of academic intervention with the lowest difference in learning impact were Communication and Language with a 17 percentage point difference in learning between physical and virtual classes, and Social Emotional Development with a difference of 29.4 percentage points. As illustrated in Table 2, ANCOVA was conducted to check if the difference in post-test scores between physical and virtual batches was statistically significant, accounting for pre-test scores as a covariate.

According to the ANCOVA test conducted between the physical and virtual batch, there was a significant effect of teaching method on SLOs achieved post training after controlling for the effect of SLOs achieved in pre-training,  $F(1, 23) = 46.09$ ,  $p$

Table 1. Paired differences in mean pre and post test scores

Batch	Dimension	Paired Mean Difference	Sig value	Statistically Significant
Physical	Communication and Language	37.38	0.000	Yes
Physical	Fine Motor Skills	52.00	0.000	Yes
Physical	Gross Motor Skills	35.92	0.000	Yes
Physical	Cognition and Play	56.08	0.000	Yes
Physical	Social and emotional development	33.31	0.000	Yes
Physical	Self Help	62.62	0.000	Yes
Virtual	Communication and Language	22.00	0.006	Yes
Virtual	Fine Motor Skills	19.54	0.032	Yes
Virtual	Gross Motor Skills	3.08	0.562	No
Virtual	Social and emotional development	2.54	0.337	No
Virtual	Cognition and Play	4.92	0.134	No
Virtual	Self Help	19.92	0.001	Yes
Physical	Total	277.46	0.000	Yes
Virtual	Total	72.00	0.001	Yes

< 0.001. Every dimension was statistically significantly impacted by the mode of teaching (physical/virtual) except communication. Eta square values were highest for Cognition and Play (0.771)

and Self Help (0.725), which indicates that the method of teaching had the largest impact on the scores of these dimensions.

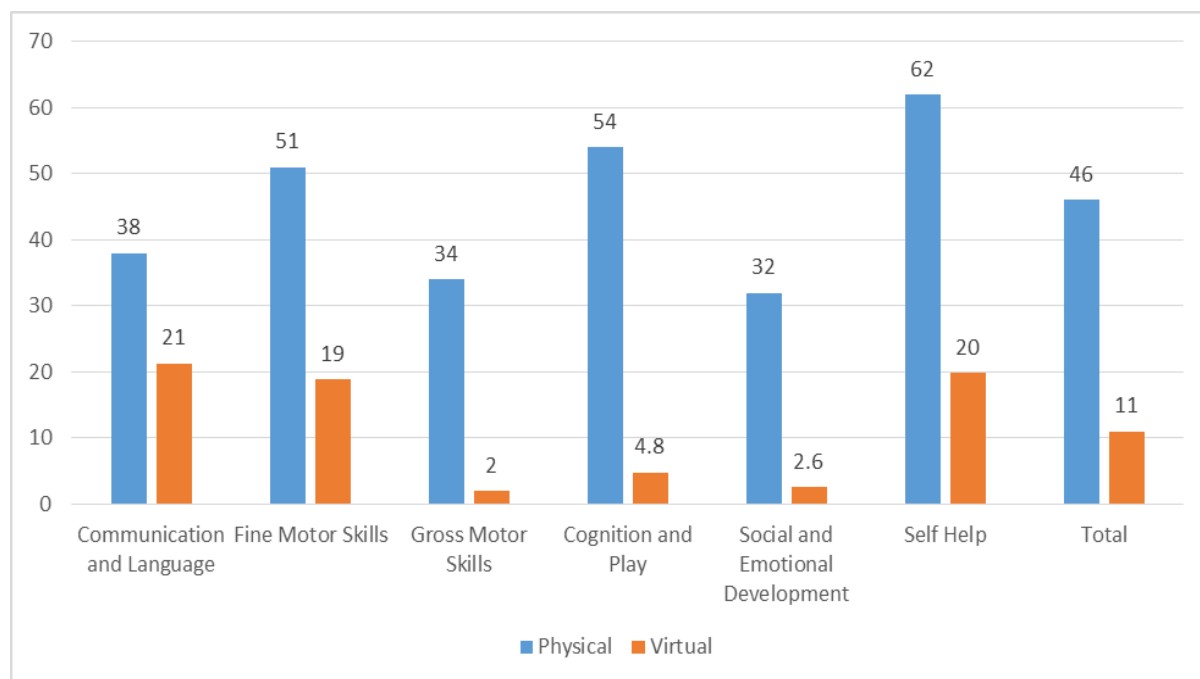


Figure 2. Difference in percentage point increase in learning mid-year in each area of intervention between physical and virtual classes

Table 2. Difference in post-test scores between physical and virtual batches

Dimension	B Value	Df	Error	F value	Eta Square	Sig
Communication and Language	16.187	1	23	2.612	0.102	0.120
Fine Motor Skills	36.722	1	23	17.895	0.438	0.000
Gross Motor Skills	27.018	1	23	6.912	0.231	0.015
Cognition and Play	61.975	1	23	77.360	0.771	0.000
Social and emotional development	39.696	1	23	8.745	0.275	0.007
Self Help	42.826	1	23	60.532	0.725	0.000
Total	209.079	1	23	46.087	0.667	0.000

## 5. Discussion

Student progress evaluation results determine that students performed better academically in the physical, in-person class format with an increase of 46 percentage points in total learning from 12% to 58%, whereas progress was lower in the virtual set-up with 11 percentage points increase in total learning from 10% to 21%. Additionally, student attendance records of the physical set-up also show a demonstrably higher percentage with an average total attendance of 76%, as compared to the virtual set-up that had an average total attendance of 64%. These results clearly indicate that physical classes were more favorable to student learning than the online classes. An observable explanation for these results could be that students received more class time in the physical set-up with a total of 120 minutes per day of hands-on student-teachers interaction, while the virtual setting afforded only 30 minutes per day of digitally-mediated class time to students. Class duration was reduced to accommodate for the young children's lowered attention span due to memory deficits [12], and limit their screen time to avoid zoom fatigue [13]. It is also crucial for young children with Down syndrome to be engaged in physical movement to maintain components of cognitive function including memory and attention span [14]. Physical activities are incorporated in EPEP class contents in areas like Gross Motor Skills and Self-help, however, movement became limited in the online class format as teachers had to rely on parents to deliver lessons in a reduced time span. Although academic results illustrate otherwise, there were a few notable advantages that came with the online learning set-up. In a survey conducted with parents of children enrolled in EPEP's virtual classes, 68% indicated that attending online classes was more convenient and had increased access to learning. The online EPEP batch had an international student admission for the first time since inception due to increased accessibility, and parents also received an opportunity to learn how to teach their children at home in a more

structured manner by attending the online classes with them. According to the same survey, 69% of the parents indicated that they experienced an increase in levels of self-confidence in terms of delivering lesson plans with their children since the beginning of the virtual academic session. Parents, particularly mothers, took on the role of a facilitator in preparing and supporting their child for a different pre-school experience, and were actively involved in the implementation of the child's academic goals at home as opposed to the minimal involvement in previous years. Parents also responded well to home assignments for reinforcement purposes with 73% submission of evidences throughout the first term in virtual setting which signifies some level of motivation and commitment to be involved in their children's academic growth. Moreover, children with Down syndrome also secured a chance to learn in a different set-up and adapt to the changing environment. Parent of a child enrolled in virtual EPEP commented on their experience:

*"I feel a lot more confident as a support to facilitate my child, after 4 months of our virtual experience, through parental guidance and timely communication from teachers."*

Another parent affirmed that:

*"when I first started reinforcing activities at home it was quite difficult to work with my child due to his low sitting tolerance and increased tantrums. I am now a lot more self-assured to use and have an idea of the different strategies needed for when my child does not comply during activities."*

Completely different experience for all stakeholders in EPEP, and the learnings will help design and conduct better future learning strategies.

On a serious note, the virtual space was well-received by both facilitators and parents, there were some obstacles that hindered overall learning for children with Down syndrome. One of the key

elements that plays into social and emotional development for students with Down syndrome is their interaction with their peers. However, this area was left nearly unattended in online classes where the students' engagement became restricted to just the facilitators conducting the class. This could be one of the reasons why progress was seen to be delayed in this area of learning. Online classes accompanied a sense of loss for that established routine as the class duration was reduced from 120 minutes to 30 minutes per day. Moreover, since group sessions were the highlight of the virtual setting, students also lost their one-on-one station time with each facilitator which could also have contributed to the steep drop in learning. Teacher proficiency was also adversely affected in virtual classes for the same reason. The station-based format in physical classes ensured at least 8 minutes of focused instruction time with one teacher for each area of academic intervention, whereas, in virtual sessions 15 minutes were dedicated to all areas of academic intervention with multiple facilitators in the same (zoom) room.

Students often experienced disruptions during class time due to power outages at home or unstable internet connections. This also adversely impacted student attendance, as well as their sustained classroom experience. Survey results also exhibited that 40% of the children did not have a dedicated and ergonomic student space for their classes which is essential not only for their gross and fine motor skills development, but overall academic growth as well. Physical sessions develop a sense of security and stability for students which helps them gain an understanding of everyday events and procedures as routines make their environment more predictable, resulting in improved learning. It is also important to note that EPEP is a long-running educational program for young children with Down syndrome since 2017.

The methods of instruction, class format, developmental goals, and routine interactions for physical classes were all based on experience, tried and tested conduct over the course of four years prior. The new virtual sessions were a novelty, and the latest batch studied was still in its experimental, embryonic phase. Thus, it is reasonable to argue that the results of physical class format would naturally yield better academic performance than the still nascent virtual class format.

## 6. Limitations

Our study of two different batches includes a host of limitations related to design and confounding variables. The virtual batch was conceived as a result of the COVID-19 global pandemic, hence, the format of classes could not be replicated in the same way. The pandemic's lifestyle and environmental changes may have had an impact on virtual learning, as opposed to if the virtual program had been piloted pre-Covid-19.

There was a lack of ability to ensure uniform control on the environment at home, parental involvement, equipment and lightning at home.

The scope of this study was also limited, due to the small sample size which was restricted by the mandated class size of a general EPEP classroom. The duration between each pre-test and post-test analysis is six months (1 semester) since the beginning of a new academic year, which may not be enough time to gauge accurate results. It is also important to take note that Karachi Down Syndrome Program (KDSP) is the only organization in Pakistan currently that runs a program like EPEP, and this was the first ever time a study like this has been conducted at KDSP. Children with Down syndrome are all different, and do not have the same rate of growth or existing health conditions. As such, each time the study is conducted, a different sample could lead to different results. Repeated studies are required to improve the reliability of results. Another limitation is that the sample demographic consists only of children with Down syndrome from Karachi. This creates problems in generalizing the findings to children across different cities in Pakistan. Although power outages was identified as a potential cause for drop in attendance in virtual classes, the attendance result cannot be attributed to the program set-up itself, as both programs settings (virtual and physical) have different factors influencing attendance where one (physical) might be impacted by cost of travel, and the other (virtual) could be due to power outages. There was also a lack of ability to ensure uniform control on parental involvement, and the effect of lifestyle changes due to COVID-19. These variables could not be controlled or accounted for in the study, hence they add to the limitations of this comparative study.

## 7. Conclusion

The academic success for children with Down syndrome in preschools greatly depends on their ability to focus, respond and follow instructions in class. These variables are more difficult to monitor in a virtual setting, and the set-up also does not provide an all-encompassing social experience of learning, which is essential for a child's development. According to data gathered so far, for students with Down syndrome, physical space and hands-on teaching works better for achieving learning goals. However, parental engagement and empowerment fared higher through the virtual contact.

Overall, there was no learning regression that was recorded for children with Down syndrome in a virtual class setting, but the percentage of goals achieved was drastically lower in comparison to a physical class setting. The virtual set-up, however, allowed for an expanded scope of learning for families of children with Down syndrome where they learned how to implement effective teaching strategies at

home, as a value add of having to attend their children's online classes. This also gave them a sense of confidence and ownership where the parents/caregivers felt they were well-equipped to reinforce their child's learning outside of the classroom space. The parents/caregivers also witnessed first-hand the results of their efforts when children began responding to their teaching, and received a better sense of their children's learning style and space.

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