Psychology of Education and Learning Sciences

https://journals.cypedia.net/PELS

ARTICLE

Teacher Training to Increase Accurate Language and Decisions

Julie Jones, Nicole Luke *, Kieva Hranchuk

Department of Applied Disability Studies, Brock University, Saint Catharines, ON L2S 3A1, Canada

ABSTRACT

Effective training of teachers is important for the success of students, particularly students with disabilities such as autism. Critical teaching skills include the ability to talk with accuracy about students' behavior and to create and read graphs of student behavior to allow teachers to make data-based decisions. The translation of research findings from controlled laboratory settings to the applied setting is an important step in the process of identifying and teaching critical pedagogical behavior. This case study was conducted with seven teachers of students with autism. The CABAS® Decision Protocol was used. This highly structured protocol focuses on training teachers to talk about student progress in a technical way, which can improve their ability to make accurate decisions and produce more effective teaching but is not often translated to less structured environments. Teachers were taught to increase their use of scientific language when talking about their students' progress. All seven teachers increased their use of scientific language. Four teachers were taught to improve their ability to recognize opportunities to make teaching decisions and to describe a graph accurately. All four teachers improved. These findings suggest that the decision protocol could be useful when training teachers in less structured settings. These findings provide a starting point for translation of more technical work into applied settings.

Keywords: Teacher Decisions; Teacher Training; Decision Protocol; Inclusion

*CORRESPONDING AUTHOR:

Nicole Luke, Department of Applied Disability Studies, Brock University, Saint Catharines, ON L2S 3A1, Canada;
Email: nl.behavioranalyst@gmail.com

ARTICLE INFO

Received: 1 September 2025 | Revised: 4 October 2025 | Accepted: 11 October 2025 | Published Online: 19 October 2025
DOI: https://doi.org/10.64797/pels.v1i1.119

CITATION

Jones, J., Luke, N., Hranchuk., K., 2025. Teacher Training to Increase Accurate Language and Decisions. Psychology of Education and Learning Sciences. 1(1): 19–31. DOI: https://doi.org/10.64797/pels.v1i1.119

1. Introduction

The effectiveness of behavioural intervention for children with disabilities has been well documented in the literature [1]. It has also been documented that the effectiveness of a behavioural intervention program depends on the teachers being appropriately trained [2]. Behavioural interventions, like other forms of teaching, require a concerted effort to train teachers in several different skills. There is evidence of gaps in current teacher training programs globally [3,4] and greater demand for inclusion of all students in schools [5], which requires these skills. Among those skills is the ability to make good decisions about how, when, and what to teach [6].

1.1. Teaching Skills

The decision-making process of teachers must be guided by data rather than emotion or intuition to maintain and promote effective teaching practices [7]. Researchers interviewed teachers in Belgium and discovered that the teachers relied on intuition to determine the best way forward in their teaching [8]. Teachers reported using little in the way of purposively collected data and reported that what little data they collected they did not use for decision-making in their classrooms or their plans for teaching. Intuition is unreliable and can lead to errors that negatively impact on the students' learning.

The ability to create, read, and interpret graphs are important skills for a competent teacher. Visual analysis of graphs is not an easy skill to acquire, and mistakes can be made when reading and interpreting graphs [9]. Learning to use graphs as part of regular teaching practice is important to ensuring student success. Teachers can use graphs to evaluate student progress and make decisions about changes to their teaching that can improve student outcomes [10]. Teachers require training and coaching to achieve mastery of skills necessary for creating, reading, and interpreting graphs with accuracy.

Teachers often lack confidence in their skills to interpret and apply their knowledge using graphs [11]. Researchers surveyed 101 teachers and provided brief training to 24 teachers, where even brief training helped teachers feel more confident in their skills, but this appeared to increase their reported intention to use their student data in the future.

Kranak and colleagues [12] used Behavioral Skills Training to teach graphing skills to graduate students. Using a single-subject design (SCD) [13], three students successfully learned to create graphs accurately and fluently. The study was limited to creation of graphs, however, and did not examine reading and interpreting graphs for instructional decision making.

Toste and colleagues [7] found that visual analysis of graphs was insufficient to produce accurate decision making on the part of 32 preservice special education teachers in the U.S. These findings suggest that not only is it important for teachers to learn to read graphs, but they need guidance and training, including the use of protocols, to make consistent and accurate decisions. They also need accurate language to talk about what they are seeing in the data.

1.2. Behavioural Skills Training

There are a variety of ways to provide teacher training and ensure that teachers acquire the necessary skills, including modelling, practice, and feedback, as well as provision of models or protocols [14]. One common strategy used to train teachers is that of Behavioural Skills Training (BST). In a study by Sarokoff and Sturmey [15], BST was used to improve the use of Discrete Trial Training (DTT) for three staff members working with children with disabilities. A multiple baseline design across participants was used to assess the effects of the intervention on staff and student performance. Baseline consisted of the percentage of correct use of DTT out of 10 opportunities while working with a child with disabilities. Training consisted of trainers modeling appropriate use of DTT with a child, and in-the-moment feedback containing positive reinforcement, and feedback for areas in need of improvement. All three staff acquired DTT skills with one child and one set of teaching programming. During baseline, all three staff members scored below 50% for correct implementation of DTT, and correct responses for students during this baseline period were also below 50%. Following the treatment phase, all three staff members scored above 90% for correct implementation, and correspondingly correct responses for students were also above 90%. The use of BST to increase staff's correct implementation of DTT was successful in improving staff performance, while simultaneously improving student performance. This study demonstrates the effectiveness of BST in improving staff skills and highlights that improved skills in staff are directly related to student performance.

A functional relationship was demonstrated between the use of BST and accurate implementation of a Universal Protocol treatment package by a special education teacher using a single case, multiple-baseline-across-settings design [16]. The BST model components emphasize modeling, practice, and feedback as critical to include when training new skills.

In one study, 67 preservice teachers were trained using either a data-based decision-making model (DBDM) with online training, a DBDM with no online training, or had no training at all [17]. Researchers investigated data pattern identification accuracy and decision-making accuracy across multiple graphs. They found increased accuracy equally with the use of the DBDM with online training or alone, suggesting that a model or protocol alone may be sufficient to produce accurate teacher behavior in these areas.

1.3. Relationship between Teacher Performance and Student Outcomes

There is evidence to support the assertion that increased skills for teachers will translate into improved teaching and that this will, in turn, lead to improved learning [18]. Increased support from the teacher led to improved outcomes for eighth grade Chinese students in math in one study [19]. Teachers in the study required sufficient skills in math to provide the necessary support to their students. Longitudinal research into the relationship between teacher expertise and student outcomes in German secondary school mathematics classes suggested that teachers' high content knowledge, enthusiasm, and self-regulatory skills were predictive of improved student outcomes [20]. They did not find that teachers' general academic knowledge improved the results of their students. Their findings suggested the importance of creating a multi-dimensional model of teacher professional competence. These findings also suggest that further research should be done in this area as they did not investigate teachers' ability to make accurate decisions in the teaching context. Another large-scale study found a significant relationship between teaching experience, classroom instruction, and student outcomes for secondary school science students in the United States [21]. Variance in student performance was found to be related to variance in teaching, but further research is needed to understand the nuances of such complex interactions.

Suhrheinrich and colleagues [22] are reportedly investigating the development of an interactive decision tree to guide teachers in their use of Classroom Pivotal Response Teaching (CPRT), but they have yet to report their results or findings, highlighting the need for additional research in the area of teacher decisions.

1.4. CABAS® Decision Protocol

Singer-Dudek and colleagues [23] conducted a comparative analysis of the Comprehensive Application of Behaviour Analysis to Schooling (CABAS®; www.cabasschools.org) model of education. The paper describes the effectiveness of the CABAS® Model that has been in place for the past 20 years. The CABAS® model aims to improve educational opportunities through the use of data across all components of the model. The advantage of this model is its formal structure. The disadvantage of this model is its requirement for a high level of training on the part of the staff. CABAS® schools and programs are unique.

One component of this model played an integral role in the development of the current staff training package: the use of a decision tree protocol (CABAS® Decision Protocol). This protocol is a set of rule-governed decisions that are to be made by teachers based on visual inspection of graphs. A well-trained teacher can immediately spot problems and analyze what is impacting the student's progress. The protocol includes rules for when to intervene and make decisions relative to the student's performance. The first and second levels of decisions include identification of ascending and descending data trends, as well as the presence of no trends during visual inspection and identifying when a student has met mastery criterion. Higher levels of decisions include the analysis of where the problem may lie within the context of the learning opportunity and then making changes based on the tactics from the literature. The current study used this decision protocol as a training and measurement component.

Keohane and Greer [24] tested the effects of staff's use of verbally rule governed algorithms to solve students' learning problems. Teachers were taught to analyze students' responses to instruction using a strategy protocol related to rule governed behaviour. A multiple baseline across three teachers and six students was used to determine whether an increase in staff's use of rule governed decisions led to an increase in student learning. Correct and incorrect decision opportunities were collected during graph checks in baseline and following the training. A hierarchy of levels of decisions were used, including basic levels, in which teachers drew a line to indicate a phase change; mid-levels, in which teachers selected a procedure from the tactics of the science to initiate phase changes; and high levels, in which teachers used a rule governed analysis of the learn unit to solve an instructional problem as indicated on the graphs. In-situ training was used and there was regular monitoring for reliability of programming and data collection using the Teacher Performance Rate and Accuracy (TPRA) observation form [25,26]. This is a tool to assess correct presentation of learn units and the staff's accuracy of responding and recording.

Teachers were also trained to graph and analyze data associated with each student's program graphs using a generic set of rules regarding decision opportunities. The rules for data-based decisions were 1) Three descending data points requires a change; 2) Three data points at criterion requires a change; and 3) Three data points with no trend requires a change. Regular graph check meetings were held throughout the teaching phase, which included feedback regarding data-based decisions. Results indicated a functional relationship related to changes in teachers' decisions. As correct rule governed data-based decisions increased, students achieved significantly more objectives. This correlation between increased student achievement and improved teacher repertoires suggests a significant effect on learner outcomes when the teaching abilities are improved.

Frank and colleagues [27] used a decision protocol to assist teachers in making data-based decisions related to toilet-training preschoolers with disabilities. The goal was to guide the selection of interventions, assess student progress, and make changes to the plan if students weren't making sufficient progress. The use of the decision protocol relied on creating, reading, and interpreting graphs of each child's behaviour. Teachers learned to follow the decision protocol and children were successfully toilet trained. Teachers in this study were highly trained and fluent in the CABAS® teacher training curriculum.

The CABAS® Decision Protocol has not been well researched outside of the CABAS® model schools but has been highly effective within them. This study proposed to apply the use of the CABAS® Decision Protocol to a novel setting where teachers were not already trained in the CABAS® Model and were working in a therapeutic setting within a different educational system. The supervisor in this setting had only casual contact with the training and methods of the CABAS® Model and did not have CABAS® certification or qualification. The supervisor integrated the decision protocol and its steps into her own already established training and mentoring processes at her teaching site. She did so with support and direction from a consultant with CABAS® qualifications. This was intended to allow investigation of the decision protocol outside of the structured CABAS® system.

The current study investigated the use of the CABAS® Decision Protocol when integrated into an existing teacher training system in a treatment centre in Canada where teachers worked with children with disabilities in a team approach and with supervision from a behaviour analyst. The decision protocol was taught using the BST model.

The research aims of this study were to determine if the addition of the decision protocol led to increases in teacher behaviours such as the use of precise language to talk about student performance, the ability to analyze graphs, and the ability to make data-based decisions accurately.

2. Materials and Methods

2.1. Setting and Participants

This correlational case study [28] was conducted at a day treatment centre for students with disabilities in Southeastern Canada. Students in the program ranged from three to eight years of age and were referred to the program for services intended to prepare them for successful entry into the public school system. Services were funded by the provincial government. Classrooms consisted of seven students and seven teachers who worked in both a 1:1 configuration as well as in small group instruction, depending on the goals and objectives for the individual student. Classrooms were overseen by a supervisor. Each student had an initial assessment, which the supervisor used to develop a set of goals and objectives individualized to the student but all with the goal of transitioning the student to a public-school setting, either in an inclusion classroom or into a special education self-contained classroom. Progress towards goals and objectives was reviewed every six months with the family. Students attended the program for an average of six hours per day, five days per week. Each teacher was assigned primary responsibility for at least one student. The primary teacher was responsible for maintaining daily records of student progress on instructional goals and objectives. Instructional goals for students were typically organized in several different domain areas, including self-help skills, academic skills, communication skills, and social skills.

Teachers were a range of ages (23–35 years) and a range of education levels (high school diploma to bachelor's degree completion in a related field). All teachers were required to complete provincial training on initial hire to a position in the program. The provincial training lasted approximately two weeks and required passing a performance evaluation to move to full time work in the program. Teachers were assigned a primary student but taught across the classroom, taking responsibility for teaching typically three or four of the seven students in the team's classroom. All teachers on the team had responsibility to work with all the students at some time and to work together during group activities or time periods throughout the instructional day. Instructional days were structured similarly to a public-school setting, with instructional time scheduled during the morning, a lunch period and recess periods, and instructional time scheduled during the afternoon. Students arrived at the program either on school buses or were transported by their families.

Seven teachers were recruited to participate in this research. All seven teachers were female and had at least successfully completed provincial training. Four had at least one year of experience teaching in the program. The other three were new teachers in the program within the past six months. Informed consent was obtained from all the participants involved in the study.

The supervisors for the classroom served as the primary researchers for this study. They were female, 27 years of age, and had five years of experience teaching in the program. They were enrolled in a graduate school program where they were completing studies towards a master's degree. The supervisor was on site, supported teaching staff daily and held weekly team meetings with the team of seven teachers. They also held individual supervision meetings with each teacher monthly. The supervisor observed each teacher working with the students on a weekly basis. The supervisor was supported by a consultant who had 20 years' experience as an educator, had completed a doctoral degree in education, was CABAS® qualified, and was present on site at the program on a weekly basis for approximately 8 h per week.

2.2. Procedures for Teacher Training Intervention

A single case experimental design was used for this study [29]. Single case design research offers an effective method for evaluating the evidence necessary to make recommendations about best practices in education [30]. It is a good research design for exploratory research in a natural setting and allows for close investigation of the phenomena of interest with the intention of generalizable findings [28].

The study began with baseline data collection of all three dependent variables for four teachers. The dependent variables were rule governed data-based decisions, use of scientific tacts during educational discussions, and comparison of performance scores on a knowledge test before and after training. Three more teachers were added to the instructional team and participated in the trainings, but baseline data for these three could only be collected on performance scores on a knowledge test due to the fact that they had not been with the team before the trainings and so had no prior opportunity to make decisions or use tacts.

There were two independent variables introduced during intervention—Rapid Data Presentations (RDPs) and Tutorials. The independent variables for data-based decisions were modelling and feedback throughout a series of mini presentations by teachers, called Rapid Data Presentations (RDPs) [24]. RDPs consisted of weekly 30-min meetings in which teachers presented a graph. There were five phases for the RDPs, which included 1) teachers presented graphs and tacted all components of the graph with a sheet of paper that directed them on what to describe; 2) this step was the same as the first, however, teachers were no longer able to use a "cheat sheet"; 3) teachers not only tacted the components of the graph, but also identified one phase on the graph; 4) teachers presented the same components as well as identified one phase containing a descending trend, and one phase containing a descending trend; and 5) teachers presented steps 1–2, presented three separate phases on the graph, and identified the trends within each phase. This continued until each teacher had an opportunity to present once for each of the five steps. Progress to the next step did not occur until all teachers presented accurately for the current step.

During these presentations, the supervisor modelled each phase of the presentations and provided positive feedback to each teacher following presentations. Feedback was also provided for improvement when necessary. During the series of presentations, teachers were also trained on how to identify trends and on making data-based decisions based on those trends. During this phase of training, regular binder check-in meetings were held with each teacher. Feedback was provided during the supervision sessions consistent with the protocol described in the training.

The independent variables for scientific tacts were modelling, didactic training, role playing, feedback, and group exercises through a series of five tutorials held once a week. Tutorials provided training on basic scientific language found in the applied behaviour analysis (ABA) literature, as well as tactics teaching staff used on a regular basis in the treatment centre and were created by the supervisor. **Table 1** illustrates the independent and dependent variables for the current study, and **Table 2** provides a detailed overview of the teacher training intervention.

Table 1. Independent and Dependent Variables.

Independent Variable	Dependent Variable
Rapid Data Presentations	Increased use of rule governed data-based decisions
Tutorials	Increased use of scientific tactics during clinical discussions and improved post-test scores

Table 2. Description of Staff Training Intervention.

Training Module	Procedures (Antecedents vs. Consequences)
RDPs	**Antecedents:** Modelling, repeated practice, didactic training.
	Consequences: Positive reinforcement, and constructive feedback following RDPs.
Tutorials	**Antecedents:** Didactic training, modelling, role-playing, repeated practice in small groups
	Consequences: Feedback during and following small group and individual exercises, including positive reinforcement.

2.3. Operational Definitions and Behavioural Objectives

The goal of the teacher training intervention was to increase the teachers' use of correct scientific tacts during educational discussions; increase their ability to identify trends on the graphs; and make data-based decisions when required, as per the decision protocol described above. Data for four teachers were collected on graph trend identification and data-based decisions. Data for seven teachers were collected in the scientific tacts component.

2.4. Target Behaviours

2.4.1. Correct Use of Scientific Tacts

Supervision meetings were held with each individual teacher. Teachers brought their primary students' programming binders with them, and they reviewed the graphs with the supervisor, including visual inspection of the graphs and discussion of a rationale for data-based decisions made. Each student had their own program binder which contained a collection of teaching programs, data sheets, and graphs related to the individualized program plan for that student. Most children had 20–25 teaching programs and a graph for each program. Teachers were assigned primary responsibility for one or two students. The supervisor was responsible to overseeing all seven children assigned to their team. During a 20-min period the supervisor collected data on correct and incorrect use of scientific tacts during the discussion. A tact is a term derived from the field of verbal behaviour analysis and can be defined as a term describing an item if the consequence for describing the item is a generalized type of reinforcement [31]. A scientific tact involves labels based on their observable, objective properties and does not include unobservable inferences regarding objects, items, or events. In common terms, a tact can be understood as somewhat like a "name" for something. For the current study, a correct scientific tact occurred when the teacher had the opportunity to use scientific language based on the literature and did so accurately. For example, if the teacher looked at a graph that contained a descending trend and said, "Johnny is not doing very well," this would be counted as an incorrect tact. A correct scientific tact for this example would be "there is a descending trend in this phase." Another example is when a teacher described their rationale for why a problem behaviour was increasing. For example, stating, "the behaviour is getting worse because Mom always gives in to him," would be an incorrect tact. A correct tact for this would be "there is an ascending trend, and it is possible that the reason for this is because Mom is reinforcing the behaviour." Key words are ascending, descending, or reinforcement, as opposed to "getting worse," "going up," and "giving in."

The supervisor calculated the total number of scientific tacts that were used and then scored each as correct or incorrect. Then the supervisor calculated the percentage of correct tacts made by each teacher. A sample of tacts was taken before and after the training sessions were provided by the supervisor. Seven teachers were scored on their use of scientific tacts.

2.4.2. Rule Governed Data-Based Decisions

The current study consisted of four possible types of rule-governed data-based decisions. **Table 3** summarizes the four types of data-based decisions that could have been made by the teachers and describes the operational definitions for each response. The fourth type of decision (ID of probes or pretests) was measured as a control condition because it was not trained during intervention.

Table 3. Operational Definitions of Rule-Governed Data-Based Decisions.

Operational Definitions
Indicates when student criterion is achieved for each phase.
A correct rule governed data-based decision is when the staff drew a phase change line (vertical broken or solid line) on the program line graph for their primary student, which indicated that a change was made. The rationale for making the change was written briefly either on the top of the phase or on the back of the graph.
Continues phase when the data demonstrates an ascending trend.
Ascending trend: 4 consecutive data points and 3 paths in an upward direction with no change in direction (the next data point without any change is a correct decision), or 6 consecutive data points and 5 paths if there is a change in direction
Implemented a phase change when no progress is made.
Implement phase change line with rationale when the data demonstrates a flat or descending trend across 4 consecutive data points, 3 paths if there is no change in direction, or 6 consecutive data points, and 5 paths if there is a change in direction. Rationale must be written on the phase at the top of the graph, or on the back of the graph. Rationale does not have to be as per protocol for decisions. If there is any rationale, it is acceptable.
Including generalization probes and pretests where appropriate.
At the beginning of a new phase and teaching target, staff wrote an X as per the legend to represent that a pretest was conducted prior to teaching. Staff also indicated that a generalization probe was conducted by drawing an asterisk (*) above the data point in the session following mastery criterion.

Note: **Table 3** includes operational definitions for all rule-governed data-based decisions made by the participants.

The graphs from the teacher's primary students were reviewed by the supervisor. The supervisor calculated the total number of opportunities to make a data-based decision, coded them by type, scored them as correct or incorrect decisions and then calculated the percentage of correct decisions made by each teacher.

2.4.3. Exam Scores on Training Content

Teachers were tested on the content from the staff trainings that were led by the supervisor. Content included detailed training and rationale for all components of the decision protocol, training on common terminology, and training on the expectations for data collection and reporting as part of the job expectations in the teaching role. Each training was held at the end of the workday during regularly scheduled team meetings with all the teachers and the supervisor gathered in a group. Trainings lasted an average of 30 min and were part of the paid time for teachers. Attendance at the training meetings was mandatory. Team trainings were presented as didactic tutorials.

2.5. Data Collection Methods and Baseline

Percentage of correct rule-governed data-based decisions out of 100 opportunities for each of the seven teachers was collected in the baseline and post training phases. Percentage was determined by dividing total correct decisions by 100 (total number of opportunities) and multiplying by 100. Each teacher was responsible for the upkeep, data analysis, and preparation of programming graphs for one student (i.e., their primary student). Data were collected for each teacher on data-based decisions for their primary students only during baseline and following intervention. Data were also collected on correct use of scientific tacts during a one-to-one 20-min educational discussion with the supervisor in baseline and post training phases. Percentage of correct scientific tacts per opportunity within the 20-min blocks were collected. A percentage was determined by dividing the total correct tacts by the total opportunities and multiplying by 100. The data for rule governed data-based decisions including the control condition of a type-4 decision, scientific tacts for each teacher, and test scores, can be found in **Figures 1–4**.

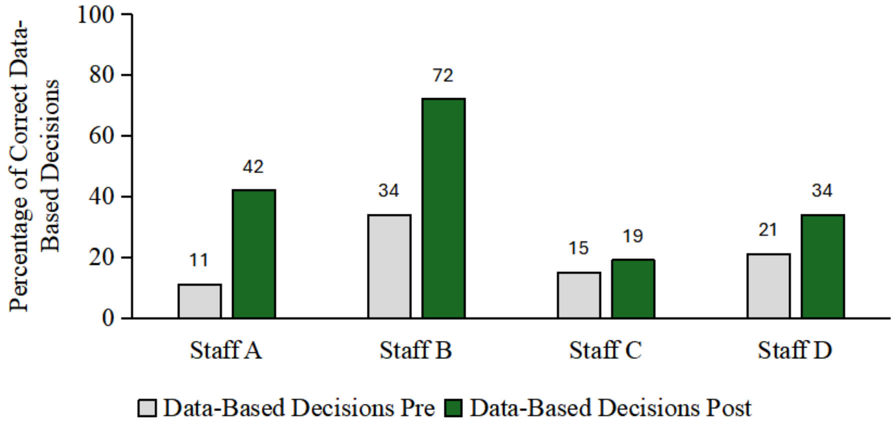

Figure 1. Pre- and Post-Test Results on Use of Rule-Governed Data-Based Decisions.

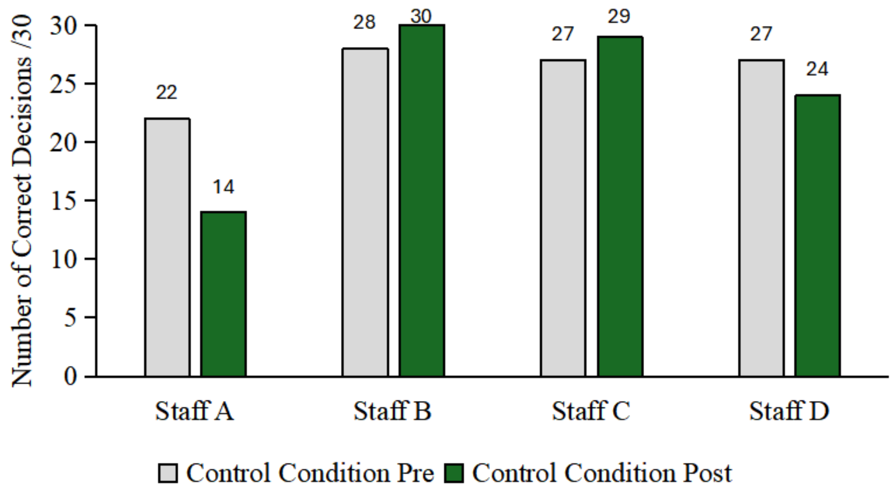

Figure 2. Pre- and Post-Intervention Results for Control Condition.

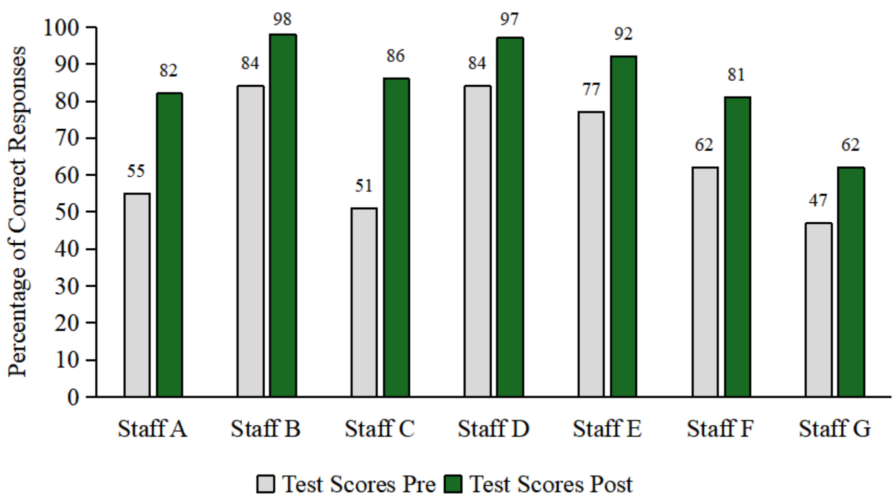

Figure 3. Pre- and Post-Tutorial Test Scores for Each Staff Member.

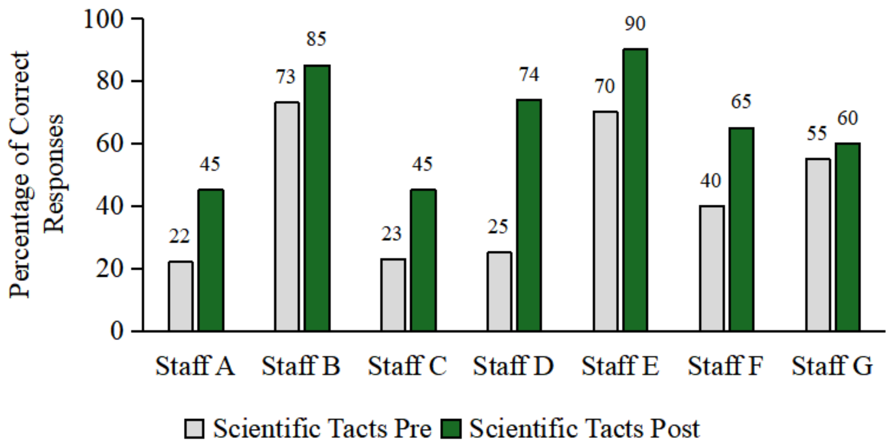

Figure 4. Pre- and Post-Test Results on Use of Scientific Tacts.

2.6. Interobserver Agreement

Interobserver agreement (IOA) was calculated using the total number of agreed items (both correct and incorrect responses) and dividing by the total number of items and multiplying by 100. This type of IOA is often referred to as Trial-by-Trial IOA [32]. IOA was calculated for 100% of the baseline probes for data-based decisions. Agreement scores ranged from 79%–100%, with a mean of 94%. IOA was also calculated for 100% of the baseline probe sessions for the knowledge test. Agreement scores ranged from 94%–100%, with a mean of 97%.

3. Results

Results indicated that use of RDPs correlated with increasing teachers' use of rule governed data-based decisions. Although results varied from teacher to teacher, there was an overall increase in data-based decisions following RDPs (see **Figure 1**). Data were also collected on correct use of pretests and generalization probes; however, this served as a control condition, in that the use of pretests and generalization probes was not a focus of the training. **Figure 2** demonstrates the baseline and post-RDP scores for teachers' use of these two components. These results indicate that there was no significant difference between baseline and post-intervention scores. RDPs focused on when a trend was established and when a phase change was expected. The quality of the data-based decisions was not targeted in this phase; however, it was targeted in the follow-up phase. Interestingly, during the post-intervention data collection phase, most of the teachers correctly identified and indicated when a change was required by placing a check mark and/or writing "continue" on the graph. Although this was counted as an incorrect opportunity (as there was no rationale), this was not surprising as the focus of the RDPs was on learning when a trend develops and when to make changes, but it did not focus on what types of changes to make (a skill also targeted in the next phase). Overall, the data support that learning occurred for all four teachers, and there was a clear correlational relationship between RDPs and data-based decisions. Results for scientific tacts indicated that the use of tutorials correlated with improving scientific language during clinical discussions. **Figure 3** displays the data for the pre- and post-tutorial test scores, and **Figure 4** displays the results for the scientific tacts.

4. Discussion

The current study aimed to increase teachers' use of scientific tacts as well as their ability to identify trends and make rule governed data-based decisions using their primary students' educational programming graphs. Feedback from teachers was that the training was helpful and relevant to their positions. They also reported feeling more confident about their skills [7]. Anecdotally, teachers increased engagement during educational team meetings and more readily relied on the graphs when reviewing student progress. These findings are consistent with previous use of this same protocol [24].

Instructional decision making is a complex process and skills related to graphing data for visual analysis to assist in that process are increasingly required for teachers in a variety of educational settings and for both students with and without disabilities. Graphs play an important role in a teacher being able to connect student data to instructional decision making. Improving decision making of teachers may be affected by the graphing skills of those teachers, making it imperative to understand what makes a teacher an expert at using graphs to help them with their work [33].

Decision protocols can be used across a wide range of teaching skills. Evanko and colleagues [34] trained graduate students to follow a decision protocol when making ethical decisions so that they could improve their decision-making and problem-solving skills. The authors recommended teaching individuals to create their own decision models to help them work through problems. Models like the one presented here in this paper might point the way forward for teachers wishing to develop their own problem-solving skills and may be a sufficient condition for skill acquisition [17].

While regular education teachers may feel unprepared for students with disabilities in their classrooms, the students may be ready to enter their classrooms now. Research findings suggest that inclusive models of teaching are producing superior outcomes to isolated special education classrooms [5] and the movement towards inclusion is rising globally. Teachers must be prepared to welcome students into their classrooms regardless of their differing abilities [3,4].

Teacher stress and burnout because of ineffective teaching or poor-quality teaching have an adverse effect on student outcomes. Researchers looked at this relationship particularly with teachers who worked with young students with disabilities and found that teacher stress, emotional exhaustion, and depersonalization led to poor IEP outcomes through teaching quality and student engagement [35]. Strategies such as those proposed in this study could help to ameliorate these types of negative effects in the teaching environment.

School psychologists are frequently called upon to make decisions based on assessment data and recommend supports and services for students in school settings. Teachers, administrators, and school support staff were taught decision making skills to assist school psychologists in identifying students who needed support [36]. While the accuracy of data collection was affected little by the training, the ability to use data to inform intervention was increased. Findings from this study were limited by the fact that the study used vignettes rather than real-life examples, but the results were still significant. These findings suggest that teachers can learn to make better decisions with training and that this type of training is important. Teachers in the study learned to interpret graphs as a necessary part of their decision-making process. This is consistent with the current study in its focus on teaching graph interpretation to participants.

Limitations and Future Research Directions

This case study employed a training package with several components to effect the changes in teacher behaviour. Future research should examine the components of the training package to determine whether there are some components that are more effective than others and whether the components might have some efficacy on their own which could merit their use alone as a more efficient way to achieve the same effects. A cost-benefit analysis could be conducted in future research to determine the least number of resources needed to bring the greatest benefit to the educational setting. Research findings in a study of South African elementary grade teachers suggest that initial training alone may be fairly cost ineffective but that when initial training is coupled with coaching and follow-up support the cost effectiveness increases [37]. Sustaining the effects of good training and coaching could end up being an important part of any teacher training plan. If a decision protocol and training package such as the one in this study were maintained as a regular part of the program, the effects could be significant over time and could produce sustained improvements in student learning outcomes.

There were several limitations to this study. It employed a correlational design, which is a weaker design. Future research should employ SCD research designs with a stronger, functional relationship, establishing the experimental control necessary to contribute to an evidence base for these practices in teacher training. Additionally, the necessarily small sample size necessitates the need for additional research which could contribute greater numbers of participants [22]. Researchers could also consider the value of large group designs with control groups who do not receive the training as another way to contribute to the evaluation of these teacher training technologies. Future research should also include data collection on the students' performances and outcomes of their program plans [18]. It is important to understand the relationship between the improvements in teacher's skills and the benefits for their students.

5. Conclusions

In conclusion, the findings from this study suggest that there is value in prioritizing teacher education to include a sustainable program with measurable outcomes for both teacher performance, with clearly defined behavioural objectives and student outcomes, with clearly defined behavioural objectives. This study demonstrated successful translation of a highly effective, protocol-driven model (CABAS®) outside of its highly structured native school systems and into a standard therapeutic treatment facility using a non-certified supervisor. This could be used as a blueprint for scalability in global inclusive systems. Participants in this study learned to read graphs, talk about them accurately, and use them to make decisions. Teachers who participated in this study learned educational content to help them do their jobs more effectively and all participants reported finding the training package satisfactory. Teachers need opportunities to learn and then to practice what they learn in the real-world classrooms where they work. Research needs to support the practical application of findings so that evidence can inform and drive positive changes in educational settings that support the advancement of both the learning teacher and the student learners, regardless of their classification.

Author Contributions

Conceptualization, N.L.; methodology, N.L.; software, N.L. and J.J.; validation, J.J.; investigation, K.H.; data curation, J.J.; writing—original draft preparation, J.J.; writing—review and editing, K.H.; visualization, K.H.; supervision, N.L. All authors have read and agreed to the published version of the manuscript.

Funding

This work received no external funding.

Institutional Review Board Statement

This study was conducted in accordance with the Declaration of Helsinki and approved by the Brock University Office of Research Ethics (File number: 21-011).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data that support the findings of this study are available from the first author, but restrictions apply to the availability of these data, which were used under licence for the current study and so are not publicly available. The data are, however, available from the authors upon reasonable request in an anonymous form.

Conflicts of Interest

The authors declare no conflict of interest.

AI Use Statement

The authors declare that no artificial intelligence (AI) tools were used in the preparation of this manuscript.

References

[1] Howlin, P., Magiati, I., Charman, T., 2009. Systematic review of early intensive behavioral interventions for children with autism. American Journal on Intellectual and Developmental Disabilities. 114(1), 23–41.

[2] Downs, A., Downs, R.C., Rau, K., 2008. Effects of training and feedback on discrete trial teaching skills and student performance. Research in Developmental Disabilities. 29(3), 235–246. DOI: https://doi.org/10.1016/j.ridd.2007.05.001

[3] Ahmed, S.K., Jeffries, D., Chakraborty, A., et al., 2021. Protocol: Teacher professional development for disability inclusion in low- and middle-income Asia-Pacific countries: An evidence and gap map. Campbell Systematic Reviews. 17(4). DOI: https://doi.org/10.1002/cl2.1201

[4] Sepúlveda-Vallejos, S., Lizana-Verdugo, A., Valdevenito-Gonzalez, K., et al., 2026. Analytical reasoning and evidence-based decision-making in initial teacher training: A systematic review (2014–2024). Multidisciplinary Reviews. 9(9), 2026411. DOI: https://doi.org/10.31893/multirev.2026411

[5] Tremblay, P., 2013. Comparative outcomes of two

instructional models for students with learning disabilities: Inclusion with co-teaching and solo-taught special education. Journal of Research in Special Educational Needs. 13(4), 251–258. DOI: https://doi.org/10.1111/j.1471-3802.2012.01270.x

[6] Wolfe, K., McCammon, M.N., LeJeune, L.M., et al., 2023. Training preservice practitioners to make data-based instructional decisions. Journal of Behavioral Education. 32(1), 1–20. DOI: https://doi.org/10.1007/s10864-021-09439-0

[7] Toste, J.R., Filderman, M.J., Clemens, N.H., et al., 2025. Graph out loud: Pre-service teachers' data decisions and interpretations of CBM progress graphs. Journal of Learning Disabilities. 58(1), 33–45. DOI: https://doi.org/10.1177/00222194241231768

[8] Vanlommel, K., Van Gasse, R., Vanhoof, J., et al., 2017. Teachers' decision-making: Data based or intuition driven? International Journal of Educational Research. 83, 75–83. DOI: https://doi.org/10.1016/j.ijer.2017.02.013

[9] Friel, S.N., Curcio, F.R., Bright, G.W., 2001. Making sense of graphs: Critical factors influencing comprehension and instructional implications. Journal for Research in Mathematics Education. 32(2), 124–158. DOI: https://doi.org/10.2307/749671

[10] van den Bosch, R.M., Espin, C.A., Chung, S., et al., 2017. Data-based decision-making: Teachers' comprehension of curriculum-based measurement progress-monitoring graphs. Learning Disabilities Research and Practice. 32(1), 46–60. DOI: https://doi.org/10.1111/ldrp.12122

[11] Belmonte-Mulhall, C.P., Harrison, J.R., 2023. Multi-tiered systems of support: A pilot study of teacher interpretation and application of graphed behavioral data. Journal of Applied School Psychology. 39(2), 151–178. DOI: https://doi.org/10.1080/15377903.2022.2113945

[12] Kranak, M.P., Shapiro, M.N., Sawyer, M.R., et al., 2019. Using behavioral skills training to improve graduate students' graphing skills. Behavior Analysis: Research and Practice. 19(3), 247–260. DOI: https://doi.org/10.1037/bar0000131

[13] Kratochwill, T.R., Horner, R.H., Levin, J.R., et al., 2023. Single-case intervention research design standards: Additional proposed upgrades and future directions. Journal of School Psychology. 97, 192–216. DOI: https://doi.org/10.1016/j.jsp.2022.12.002

[14] Gorowara, C.C., Brownstein, E.M., Wall, T.J. (Eds.), 2023. Effectively Using Data for Educator Preparation Program Improvement, 1st ed. Information Age Publishing Inc.: Charlotte, NC, USA.

[15] Sarokoff, R.A., Sturmey, P., 2007. The effects of instructions, rehearsal, modeling, and feedback on acquisition and generalization of staff use of discrete trial training and student correct responses. Research in Autism Spectrum Disorders. 2(1), 125–136. DOI: https://doi.org/10.1016/j.rasd.2007.04.002

[16] DeMuesy, R.W., Clark-Shofar, A., 2025. Training a special education teacher to implement a Universal Protocol treatment package: Effects on challenging behaviors. Education Sciences. 15(6), 675. DOI: https://doi.org/10.3390/educsci15060675

[17] McCammon, M.N., Wolfe, K., Gao, R., et al., 2025. Training preservice teachers to make data-based decisions: A comparison of two interventions. Remedial and Special Education. 46(1), 18–30. DOI: https://doi.org/10.1177/07419325231222482

[18] Hebbecker, K., Förster, N., Forthmann, B., et al., 2022. Data-based decision-making in schools: Examining the process and effects of teacher support. Journal of Educational Psychology. 114(7), 1695–1721. DOI: https://doi.org/10.1037/edu0000530

[19] Lu, H., Chen, X., Qi, C., 2023. Which is more predictive: Domain- or task-specific self-efficacy in teaching and outcomes? British Journal of Educational Psychology. 93(1), 283–298. DOI: https://doi.org/10.1111/bjep.12554

[20] Kunter, M., Klusmann, U., Baumert, J., et al., 2013. Professional competence of teachers: Effects on instructional quality and student development. Journal of Educational Psychology. 105(3), 805–820. DOI: https://doi.org/10.1037/a0032583

[21] Fischer, C., Foster, B., Mccoy, A., et al., 2020. Identifying levers related to student performance on high-stakes science exams: Examining school, teaching, teacher, and professional development characteristics. Teachers College Record. 122(2), 1–64. DOI: https://doi.org/10.1177/016146812012200202

[22] Suhrheinrich, J., Wang, T., Chan, J., et al., 2022. Developing an empirically-based adaptation an training model for intervention scale up of classroom pivotal response teaching: A protocol paper. International Journal of Educational Research Open. 3, 100107. DOI: https://doi.org/10.1016/j.ijedro.2021.100107

[23] Singer-Dudek, J., Speckman, J.M., Nuzzolo, R., 2010. A comparative analysis of the CABAS® model of education at the Fred S. Keller school: A twenty-year review. Behavior Analyst Today. 11(4), 253–265. DOI: https://doi.org/10.1037/h0100705

[24] Keohane, D.-D., Greer, D.R., 2005. Teachers' use of a verbally governed algorithm and student learning. International Journal of Behavioral Consultation and Therapy. 1(3), 252–271. DOI: https://doi.org/10.1037/h0100749

[25] Hranchuk, K.S., Williams, M.J., 2021. Addressing the feasibility of the teacher performance rate and accuracy scale as a treatment integrity tool. Behavioral Interventions. 36(2), 355–368. DOI: https://doi.org/10.1002/bin.1774

[26] Ross, D.E., Singer-Dudek, J., Greer, R.D., 2005. The teacher performance rate and accuracy scale (TPRA):

Training as evaluation. Education and Training in Developmental Disabilities. 40(4), 411–423. DOI: https://doi.org/10.1177/215416470504000410

[27] Frank, M.R., Kim, J.Y., Fienup, D.M., 2020. The effects of a decision-protocol informed toilet training intervention for preschoolers with disabilities. Journal of Developmental and Physical Disabilities. 32(3), 477–488. DOI: https://doi.org/10.1007/s10882-019-09703-2

[28] Tight, M., 2017. Understanding Case Study Research: Small-Scale Research with Meaning, 1st ed. SAGE Publications Ltd.: London, UK. DOI: https://doi.org/10.4135/9781473920118

[29] Green, J.L., Green, J., Camilli, G., et al., 2006. Handbook of Complementary Methods in Education Research, 3rd ed. Routledge: New York, NY, USA. DOI: https://doi.org/10.4324/9780203874769

[30] Plavnick, J.B., Ferreri, S.J., 2013. Single-case experimental designs in educational research: A methodology for causal analyses in teaching and learning. Educational Psychology Review. 25(4), 549–569. DOI: https://doi.org/10.1007/s10648-013-9230-6

[31] Skinner, B.F., 1957. Verbal Behavior. Elliott, R.M., MacCorquodale, K. (Eds.). Prentice-Hall: Hoboken, NJ, USA.

[32] Cooper, J.O., Heron, T.E., Heward, W.L., 2020. Applied Behavior Analysis, 3rd ed. Pearson: Hoboken, NJ, USA.

[33] Stecker, P.M., 2017. Reflections on teachers' data-based decision making. Learning Disabilities Research & Practice. 32(1), 71–72. DOI: https://doi.org/10.1111/ldrp.12128

[34] Evanko, C.D., Matthews, K., Caruso-Anderson, M., 2024. Going beyond the code: A guide to teaching decision trees to affect students' ethical choice-making behavior. Behavior Analysis in Practice. 18, 743–755. DOI: https://doi.org/10.1007/s40617-024-01008-x

[35] Wong, V.W., Ruble, L.A., Yu, Y., et al., 2017. Too stressed to teach? Teaching quality, student engagement, and IEP outcomes. Exceptional Children. 83(4), 412–427. DOI: https://doi.org/10.1177/0014402917690729

[36] von der Embse, N.P., Kilgus, S.P., Eklund, K., et al., 2022. Promoting effective decision making: Training educators to collect and use social-emotional skill assessment data to inform Tier 2 interventions. School Psychology Review. 51(5), 574–588. DOI: https://doi.org/10.1080/2372966X.2020.1827680

[37] Cilliers, J., Fleisch, B., Kotze, J., et al., 2022. The challenge of sustaining effective teaching: Spillovers, fade-out, and the cost-effectiveness of teacher development programs. Economics of Education Review. 87, 102215. DOI: https://doi.org/10.1016/j.econedurev.2021.102215