Contribution of Practice

Using Project-Based Learning to Teach Applied Behavior Analysis Knowledge and Skills to Pre-Service Teachers

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Abstract

Classroom management is a leading challenge for teachers. Applied Behavior Analysis (ABA) strategies can improve classroom management, however, there is a lack of research on teaching ABA skills. One approach to teaching new skills is Project Based Learning (PBL). Using a PBL format, this study implemented a Behavior Change Project where participants completed a project that incorporated ABA strategies. Pre- and post-assessments showed positive increases, indicating participants gained a better knowledge about ABA and classroom management strategies. Results indicate participants felt more comfortable implementing ABA strategies and designing data collection procedures. In addition, this project helped participants increase professional skills.

Keywords: *Classroom management, Applied Behavior Analysis, Project Based Learning*

Classroom management has consistently been rated as one of the foremost challenges for teachers, especially beginning and early-career teachers (Headden, 2014; Langdon, 1999; Langdon & Vesper, 2000). Part of the reason is that teachers reported inadequate preparation in the area of classroom management (Atici, 2007; Veenman, 1984). The National Council of Teacher Quality (2014) revealed that while most programs discuss classroom management, on average, teacher preparation programs dedicate only 40% of one course to classroom management (Greenberg et al., 2014). Many researchers (Range et al., 2012; Sokal et al., 2003; Westling, 2010) found that early career teachers may identify some classroom management strategies that could be implemented, but they often are not able to employ and execute these strategies in their classrooms.

Furthermore, classroom management and discipline problems are found to be stressors that are likely to cause teacher burnout (Aloe et al., 2014; Dicke et al., 2014; Klassen & Chiu, 2011; Klassen et al., 2013; Papastylianou et al., 2009; Skaalvik & Skaalvik, 2011). Teacher burnout is defined as a mental condition that develops from prolonged exposure to ongoing stress in the workplace. (Maslach & Leiter, 2016). Teacher stress and burnout have been rising throughout the years (Farley & Chamberlain, 2021). A MetLife Survey (2012) results indicated that 36% of teachers reported great stress at least several days a week in 1985 compared to 51% of teachers in 2012 (Markow et al., 2013). Gallup (2014) found that teaching ranked as one of the most stressed-out occupations in the United States. The MetLife Quality of Worklife Survey (2015) indicated that 35% of participants reported they were "often stressed" due to student discipline, and 22% of participants were "often stressed" due to classroom management.

Teacher stress and burnout have many negative effects on teacher well-being, such as emotional exhaustion, physical exhaustion, depersonalization, reduced feelings of

personal accomplishment, reduced self-efficacy, and diminished job satisfaction (Brouwers & Jackson, 2000; Maslach & Jackson, 1981; Maslach et al., 1996; Pines & Aronson, 1988; Schwarzer et al., 2000; Skaalvik & Skaalvik, 2007; Skaalvik & Skaalvik, 2010). Teacher stress levels and mental health can affect student well-being (Becker, Goetz, Morger, & Ranellucci, 2014; Milkie & Warner, 2011; Oberle & Schonert-Reichl, 2016; Schonert-Reichl, 2017). Research indicates that students who are instructed by teachers experiencing burnout are more likely to have emotional, behavioral, and social problems (Jennings & Greenberg, 2009; Ruble & McGrew, 2013). Teacher burnout can also negatively affect student achievement due to high teacher absenteeism, retirement, turnover rates, and low job performance (Ingersoll & May, 2012; Klusmann et al., 2008; Schonfeld, 2001).

In addition to teacher burnout, classroom management problems can initiate a negative classroom behavioral cycle in which student misbehavior interferes with teaching and the obtainment of learning objectives (Martin et al., 2012). Lack of classroom management and learning objective obtainment can cause teachers to internalize students' misbehavior as a reflection of their own incompetence (Aloe et al., 2014). Consequently, the teacher may create a pessimistic and unenthusiastic classroom environment, leading to more student discipline problems (Lambert et al., 2009).

The problem is that there remains a gap between classroom management research and the content taught in teacher preparation programs, which may result in extreme challenges in classroom management among these teachers (Freeman et al., 2014). One solution to enhance classroom management skills might be Applied Behavior Analysis (ABA) through Project Based Learning (PBL).

Behavior analysis is a scientific field that aims to comprehend the actions of individuals. (Association for Behavior Analysis International, n.d.). Applied Behavior Analysis (ABA) is a methodology for teaching new skills and responding to undesired or socially inappropriate behaviors (Demchak, M. et al., 2020). ABA strategies are used to promote a wide range of skills, such as, academic skills, academic engagement, on-task behavior, social skills, orientation and mobility skills, communication skills, and to reduce disruptive behavior (Briesch & Daniels, 2013; Cushing & Kennedy, 1997; Felts, 2019;

Leaf et al., 2017; Lewis et al., 2015; Makrygianni et al., 2018; Moore et al., 2019; O'Mea, 2013; Rubow et al., 2018; Skarr et al., 2014; Slattery et al., 2016). These strategies include prompting, task analysis, positive reinforcement, differential reinforcement of alternative behaviors, response cost, and extinction (Alberto et al., 2022).

Research studies demonstrate that ABA strategies have produced positive results in a variety of settings, such as one-on-one instruction, small groups, large groups, and school-wide settings (Allday & Pakurar, 2007; Bowman-Perrott et al., 2015; Horner & Sugai, 2015; Kamps et al., 2011; Radley et al., 2016; Trump et al., 2018), and across various age levels and ability levels (Briesch & Briesch, 2016; Didden et al., 1997; Joseph et al., 2016). For example, Allday and Pakurar (2007) implemented an antecedent-based intervention to increase on-task behavior for three middle school students in a general education classroom. To increase on-task behavior for high school students with high-incidence disabilities such as attention deficit hyperactivity disorder (ADHD), Williamson et al. (2009) employed an intervention that utilized a group-dependent contingency program that used preferred student reinforcers. Similarly, Radley et al. (2016) used a class-wide intervention to increase academic engagement and decrease classroom disruptions and classroom noise in three first-grade classrooms. Behavior analysis has also contributed to the content and implementation of school-side intervention strategies such as School-Wide Positive Behavioral Interventions and Support (PBIS) (Horner & Sugai, 2015).

A Board-Certified Behavior Analyst (BCBA) commonly delivers ABA strategies and services. Given the fact that some school districts are not able to access these certified specialists or their services, and there is a growing need for these specialists, some school districts employ school psychologists and ask teachers to refer students to them for additional behavior assessment or behavior interventions (Sheply & Grisham-Brown, 2019). However, the teacher is most often responsible for implementing the behavior intervention plan (Flower et al., 2017). Although there is research to support the use of ABA strategies to increase skills and decrease problem behaviors in multiple types of educational settings and across various populations, many teachers are not able to implement the

intervention plan appropriately because they may not have been exposed to ABA strategies during their teacher preparation programs (Moore et al., 2017; Trump et al., 2018).

Given appropriate training, research indicates that pre-service and in-service teachers are capable to learn and implement strategies based on ABA principles. For instance, Pitts et al. (2019) trained teachers to implement interventions based on ABA strategies among students ages four through thirteen who were diagnosed with autism spectrum disorders (ASD). Results showed students' gains in the following areas: Learning skills, language skills, social and play skills, academic skills, self-help skills, and motor skills, with decreases in behaviors including Self-injurious, aggressive/destructive, and stereotyped (Pitts et al., 2019). Teachers trained with ABA strategies also showed increases in positive and proactive teacher behaviors. In a similar study, Rubrow et al. (2018) implemented The Good Behavior Game (GBG) with two teachers in classrooms containing fourth- to eighth-grade students enrolled in an alternative school for students with emotional and behavioral disorders. The GBG is a research-based intervention program grounded in behavior principles that have been shown to decrease negative behaviors and promote prosocial behavior (Bowman et al., 2015). Results indicated the GBG decreased disruptive classroom behaviors among students and increased teachers' use of praise and overall positive interactions between teachers and students. (Rubow et al., 2018). ABA knowledge and strategies can be taught very quickly and effectively to teachers. Smyth et al. (2019) held one 90-minute ABA training with special needs teachers in Northern Ireland, and the results showed increased knowledge of ABA and more positive teacher self-reported attitudes toward ABA (Smyth et al., 2019). The foundation of behavior intervention plans is functional behavior assessments, in which the teacher analyzes data to determine the function of the target or problem behavior. Grey et al. (2005) increased special education teachers' ability to conduct functional behavior assessments, design behavior intervention plans, and implement behavior intervention plans by employing an ABA training program. At the end of the study, the teacher's behavior intervention plans resulted in changes in most target behaviors, that is, there were increases in positive behaviors and decreases in negative behaviors (Grey et al., 2005). In addition, parents

reported a noticeable positive change in their children (Grey et al., 2005). Mrachko et al., (2017) implemented a Tier 1 intervention based on ABA strategies with fifth-grade general education teachers who attended behaviorally-based professional development and received email feedback that focused on teachers' responses to student problem behaviors that were maintained by teacher attention (Mrachko et al., 2017). Results showed that teacher training increased positive behaviors and decreased negative behaviors among students (Mrachko et al., 2017). In addition, most teachers' overall classroom behavior quality increased, and teacher behavior was improved in order to build a more positive learning space (Mrachko et al., 2017).

Although ABA has a strong research base to support its effectiveness for all students in various settings, there is a research-to-practice gap that could become even more significant in the future as classroom teachers are faced with the stress of classroom management and discipline problems and are not equipped with practical and effective strategies (Moore et al., 2017; Trump et al., 2018; Valentino et al., 2020). It might be critical for pre-service teachers to be exposed to and appropriately trained with ABA strategies during their coursework and teacher preparation program. However, one of the main difficulties in preparing teachers is identifying the necessary skills and tasks required to effectively teach preservice teachers how to manage their behavior to increase their participation and performance and anticipate potential problems that may arise. (Scott, 2017).

One method to teach preservice teachers to solve real-world problems and enhance problem-solving skills is Project Based Learning (PBL) (Al-Ali, 2015). PBL is a teaching method where teachers guide students through problem-solving by recognizing an issue, creating a strategy, assessing its effectiveness in reality, and evaluating the strategy while designing and implementing a project. (Wurdinger et al., 2007). The National Council of Teachers of Mathematics [(NCTM) (2000)] and the National Science Education Standards (National Research Council [NRC] (1996) stated that students need to engage in real-world problem-solving to make connections, foster reasoning skills, and communicate important concepts. In addition, the NCTM (2000) asserts,

Inquiry not only tests what students know; it presses students to put what they know to the test. It uses "hands-on" approaches to learning, in which students participate in activities, exercises, and real-life situations to both learn and apply lesson content. It teaches students not only what to learn but how to learn. (p. 22)

Research indicates that PBL supports the learning process, and preservice teachers acquire research skills, collaboration skills, and learn to take more responsibility for their own learning (Dag et al., 2017). Preservice teachers have favorable reports regarding PBL. Specifically, they indicated that PBL increases their knowledge and their ability to utilize knowledge gained in their teaching practices (Dag et al., 2017). PBL has positively influenced pre-service teachers' problem-solving skills, learning achievement, and views regarding the profession of teaching (Alrajeh, 2021; Kokotsaki et al., 2016). Moreover, pre-service teachers reported positive emotional responses to PBL experiences, and these experiences helped them overcome obstacles and discourage the effect of negative emotions (Tsybulski & Muchnik-Rozanov, 2021). In addition, PBL teaching methods have been shown to increase teachers' self-confidence in their teaching skills, professional growth, ability to overcome challenges, and collaboration skills (Tsybulsky & Muchnik-Rozanov, 2019). Finally, comprehensive projects have been shown to increase student life skills that are important for their profession, such as time-management, problem-solving, self-direction, collaboration, communication, creativity, and work ethic (Wurdinger & Qureshi, 2015).

Traditionally, PBL has not been included in teaching or implementing either ABA strategies or classroom management strategies. Nevertheless, the numerous advantages of PBL, such as enhanced self-confidence, increased motivation, increased knowledge, enhanced collaboration skills, increased time-management skills, enhanced problem-solving skills, suitability for a wide range of students, suitability for the information age, and increased positive views of the teaching profession could be beneficial to teach ABA strategies (Shpeizer, 2019).

In 2017 the Council for Exceptional Children (CEC) developed twenty-two High-Level Practices (HLPs) that capture the core principles of successful special education practices. The HLPs are organized around four domains:

collaboration, assessment, social/emotional /behavioral, and instruction (CEC, 2017). A course or course project within a teacher preparation program that combined ABA strategies and PBL could address each of these domains. Effective special educators must collaborate with other stakeholders to facilitate student success by actively listening, inquiring, providing ideas, problem-solving, and negotiating (McLeskey et al., 2017). Research shows that PBL increases collaboration skills and problem-solving skills. Educators, specifically special educators, must be able to collect and interpret assessment data to develop, implement, and modify instructional programs for students (McLeskey et al., 2017). Data collection and evaluation of student success based on objective measures are hallmarks of ABA (Trump et al., 2018). In order to students to be successful, teachers must fashion a learning environment that is stable, well-organized, and respectful (McLeskey et al., 2017). Regarding the social/emotional/behavioral domain, successful teachers concentrate on increasing appropriate behaviors through instructional approaches that utilize many opportunities to practice new skills while receiving positive feedback. ABA relies heavily on direct instruction, behavior skills training, opportunities to respond, positive reinforcement, and descriptive praise statements (Trump et al., 2018). To design and implement effective instructional programs, special education teachers must identify short- and long-term learning goals based on the student's present level of performance and their needs (McLeskey et al., 2017). ABA strategies advocate for clearly defined target behaviors, establishing a present level of performance by collecting baseline data, collecting data during the intervention, and making instructional modifications based on student data. An educator preparation program or course that teaches ABA strategies and utilizes PBL methods could address each domain within the HLPs and help preservice teachers develop and implement effective behavior interventions based on ABA principles and incorporating ABA strategies.

Purpose and Research Questions

This research project aims to evaluate the use of PBL to increase participants' knowledge of ABA strategies and increase professional skills, such as time management, collaboration, and problem-solving skills. It is hypothesized that the PBL strategies could enhance participants' knowledge of ABA strategies and increase

implementation of ABA strategies in classroom settings to increase student engagement, increase student achievement, and decrease problem behaviors. This ultimately could lead to greater overall job satisfaction, reduced teacher stress, and reduced teacher burnout.

Research Questions

1. Would participants increase their knowledge of ABA strategies through the completion of a Behavior Change Project (BCP) that incorporated PBL learning strategies?

2. Would participants become more comfortable designing and implementing interventions that incorporated ABA strategies through the completion of a BCP that incorporated PBL learning strategies?

3. Would participants enhance PBL skills, such as time management skills, problem-solving skills, collaboration skills, communication skills, and critical thinking skills, through completion of the BCP that incorporated PBL learning strategies?

Methods

Participants

Participants (n=16) were undergraduate students enrolled in a regional university and enrolled in an eight-week undergraduate online Special Education Applied Behavior Analysis course. An email was sent out to all students containing details of the research study and requesting students' permission to use their survey responses. If students chose to participate, they signed and submitted the consent form to a Dropbox located within the course. With a consent rate of 76%, sixteen participants signed consent, including fifteen females and one male. Eight (50%) participants worked in a school setting; five (31%) worked in an elementary school setting, one (6%) worked in a middle school setting, and one (6%) worked in a high school setting. All course material, interactions, and assignments were disseminated and submitted in an online format. Race/ethnicity and age data were not collected.

Description of Research Project

Throughout an eight-week asynchronous online course, participants attended online lectures, accessed recorded lectures, accessed instructional materials, and completed the BCP. All course materials were available for reference during the entire course. Participants were assigned to a group. Each group consisted of three to four peers. Assignments were submitted on a weekly basis, and participants accessed the course independently. Participants submitted assignments to an online course platform. Participants received feedback from peers in their assigned group and the professor. Then they incorporated the feedback into the final BCP project submitted at the course's end. For the BCP, participants were required to plan, implement, and revise an intervention to affect change in a functional living skill of an individual in their environment based on data. Examples include getting a child to complete homework independently, helping an individual stop biting their fingernails, getting an individual to put clothes in the clothes hamper, and helping a child sleep in their own bed. Components of the BCP and assignments related to the BCP are described below and listed in Table 1. All assignments were collected through the Desire to Learn[a] platform. An example of a completed BCP is included in Appendix A.

Behavior Change Project Components and Assignments

Subject and Behavioral Objective. For this component, participants submitted their assignment to a discussion board and were required to respond to all peer posts within their assigned group. Participants described their BCP topic and wrote a behavioral objective for the discussion. The behavior objective was required to have four components: Learner, target behavior, conditions, and criteria. Participants had to specifically identify the learner, the target behavior, the conditions in which the target behavior would occur, and the criteria for success. The chosen criteria should have set the standard for minimally acceptable performance and specified the level of student performance that would result from the intervention (Alberto et al., 2022). After reviewing feedback from peers and the professor, participants revised their behavior objectives as needed.

Recording Method. Participants identified the recording method that would be used for the BCP to collect data. Participants submitted their revised behavior objective, a narrative description of the proposed data collection method, a description of why it was appropriate

for their behavior objective, and an example of the data collection chart to their group discussion board. Examples of data collections method included: Permanent product recording, observational recording, event recording, duration recording, and latency recording. After receiving feedback from peers and the professor, participants revised their data recording system and then began collecting baseline data.

Baseline Graph and Narrative. In addition to choosing a recording method, participants submitted a graphing assignment to a Dropbox; for this assignment, participants were required to create two baseline graphs in Microsoft Excel®. Participants were required to create line graphs, label the x-axis, label the y-axis, and give the graph a title. For the Baseline Narrative, participants were required to provide a description of their baseline data, such as whether the target behavior increased, decreased, or remained stable. For this assignment, participants received feedback from the professor.

Description of Intervention and Description of Reinforcement. Based on baseline data, participants developed an intervention to increase the target behavior or increase a more appropriate behavior to replace the target behavior, called a replacement behavior. Participants were required to submit the hypothesized function of the target behavior, that is, what is the purpose of the target behavior, to their group discussion board. For example, the target behavior could serve to gain attention, gain a tangible item, gain sensory stimulation, escape attention, escape from a task, or escape from sensory stimulation (Alberto et al., 2022). In addition, participants described their proposed intervention, the type of reinforcement to be used, and the schedule of reinforcement to their group discussion board. Participants were required to use positive reinforcement. The chosen reinforcer needed to have a history of increasing the target behavior or replacement behavior; therefore, the reinforcer had to hold value for the subject. Examples of reinforcers included: Edibles, praise, stickers, preferred activities, and tokens that could be exchanged for an item or preferred activity. Participants had to choose the appropriate schedule of reinforcement; they could use a continuous or intermittent schedule. Participants received feedback from peers and the professor, implemented their intervention, and began collecting intervention data.

Intervention Graph and Narrative. Participants began collecting intervention data when their intervention was initially implemented. Participants were allowed to modify the intervention, reinforcement, or reinforcement schedule based on collected data during the intervention. If participants chose to modify their intervention, they were to record the date of change for the intervention graph to reflect the change. Once participants collected adequate intervention data, they developed an intervention graph. The participants created a line graph that was required to contain at least two phases, the baseline and intervention phases. The line graph was required to include standard graphing conventions, such as the title, x-axis label, y-axis label, baseline data, intervention data, and a vertical dashed line separating each phase. Participants were required to describe their intervention results. This section of the BCP was submitted in the final project submission in a Dropbox. Participants did not receive feedback before the final BCP was due.

Narrative on Changes. If participants changed any aspect of their intervention, reinforcement, or reinforcement schedule to increase their target behavior or replacement behavior, they provided a description of these changes. If participants did not make changes to their intervention, they were required to discuss possible changes that could be made to future projects. This section of the BCP was submitted in the final project submission in a Dropbox. Participants did not receive feedback before the final BCP was due.

Self-Management. Participants were required to identify and describe at least three strategies to promote self-management or generalization of the target behavior or replacement behavior. Participants were required to submit the description to their group discussion boards. For example, participants could introduce natural maintaining contingencies, goal setting, teach self-tracking skills, and teach self-reinforcement.

Journal Articles Summaries. Participants were required to read and summarize two research articles that shared some of the same elements as their BCP. For the research article summaries, participants were required to summarize the justification, purpose, subjects, setting, target behavior, observation procedure, intervention, results, discussion, and reaction. Participants submitted

summaries to Dropbox and received feedback from the professor.

Self-Evaluation. Participants described their BCP's strengths and weaknesses for the final section of the BCP. Participants were required to address weaknesses or Table 1.

concerns by describing possible changes and alternative strategies that could be used. This section of the BCP was submitted in the final project submission in a Dropbox. Participants did not receive feedback before the final BCP was due.

Behavior Change Project Steps

BCP Step	Description
1. Subject and setting description	• Identify the subject (can use fake names) and the setting. • Subject - Give a brief description of the subject (age, gender, and other important information) • Setting – describe each setting in which the intervention will take place in
2. Behavior Objective	• Name the target behavior in measurable, observable terms • Specify the learner, conditions, target behavior, and criteria for mastery
3. Operational Definition	• Clearly describe the target behavior so that anyone can read it and understand what target behavior you are measuring
4. Recording Method	• Describe how data will be recorded • What type of data collection procedure will be used
5. Recording Chart	• Type of recording chart is identified, completed, and includes an explanation of how data was recorded
6. Baseline Data Graph	• Create a line graph, label the x-axis, label the y-axis, and give the graph a title.
7. Baseline Narrative	• Provide a description of baseline data
8. Intervention Method	• Develop an intervention to increase the target behavior or increase a more appropriate behavior to replace the target behavior • Submit the hypothesized function of the target behavior • Described their proposed intervention,
9. Reinforcement	• Describe the type of reinforcement to be used and the schedule of reinforcement
10. Intervention Graph	• Create a line graph that contains at least two phases, the baseline and intervention phase • Include standard graphing conventions, such as the title, x-axis label, y-axis label, baseline data, intervention data, and a vertical dashed line separating each phase.
11. Intervention Narrative	• Describe their intervention results
12. Changes	• Describe changes made during the project or possible changes that could have been made

13. Self-Management/ Generalization	• Describe at least three strategies to promote self-management or generalization of the target behavior or replacement behavior
14. Journal Article 1 Summaries	• Read and summarize two research articles that shared some of the same elements as their BCP
	• Summarize the justification, purpose, subjects, setting, target behavior, observation procedure, intervention, results, discussion, and reaction
15. Self-evaluation	• Described BCP's strengths and weaknesses

Data Collection and Analysis

Participants completed the pre- and post-assessment Project Surveys before they began the BCP and after they submitted their final BCP project. This survey instrument was piloted in a previous semester and modified before usage. The two surveys were identical, except the pre-assessment Project Survey contained three additional demographic questions that assessed participants' work settings. The other nineteen survey questions were identical, and participants rated their familiarity with ABA, functional behavior assessments (FBAs), behavior intervention plans (BIPs), classroom management strategies, and data collection methods on a four-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." In addition, participants rated their level of comfort about conducting an FBA, developing a BIP, implementing a BIP, implementing classroom management strategies, designing data collection procedures to address academic concerns, designing data collection procedures to address behavior concerns, and collecting data on a four-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree." Participants were asked about the importance of collecting data on academic performance and student behavior on a four-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." Lastly,

participants were asked to rate how the BCP would develop or enhance time management, problem-solving, collaboration, and communication skills on a four-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." Participants were provided with descriptors of each rating; for example, agree means you are familiar with the vocabulary, or you can implement strategies with assistance. See Appendix B for the pre-/post-Assessment Project Survey.

The quantitative data analyses were conducted using the SPSS statistical package (version 27). The Wilcoxon Signed Rank test was used to compare the differences in participants' responses on both pre-and post-assessment surveys. It is hypothesized that participants would have significant increases in their knowledge of ABA strategies, their confidence in implementing ABA strategies, and professional skills such as time management and problem-solving skills. An alpha level of .5 is used to determine the significance level.

Results

The average scores, standard deviations, Z scores, and p-value of participants' responses for both pre-survey and post-survey are presented in the table below (See Table 2).

Table 2.

Behavior Change Project Results

	Pre	Std. Dev.	Post	Std. Dev.	Z	P
I am familiar with Applied Behavior Analysis.	3.06	0.443	3.47	0.516	-2.121	0.034*

I am familiar with Functional Behavior Assessments (FBA).	2.88	0.619	3.40	0.507	-2.309	0.021*
I am familiar with Behavior Intervention Plans (BIP).	3.19	0.629	3.60	0.676	-2.546	0.011*
I am familiar with classroom management strategies.	3.31	0.655	3.60	0.507	-1.897	0.058
I am comfortable conducting an FBA.	2.44	0.775	3.20	0.507	-2.332	0.02*
I am comfortable developing a BIP.	2.75	0.73	3.40	0.632	-2.165	0.03*
I am comfortable implementing a BIP.	3.00	0.602	3.60	0.507	-1.265	0.206
I am comfortable designing a data collection procedure to address academic concerns.	2.88	0.683	3.53	0.507	-1.508	0.132
I am comfortable designing a data collection procedure to address behavior concerns.	2.88	0.885	3.53	0.516	-2.373	0.018*
I am comfortable collecting data regarding students' academic performance.	3.31	0.885	3.53	0.516	-2.226	0.026*
I am comfortable collecting data regarding student behavior.	3.31	0.602	3.60	0.516	-1.342	0.18
I am confident in implementing classroom management strategies.	3.25	0.602	3.60	0.507	-1.633	0.102
It is important to collect data on students' academic performance.	3.56	0.512	3.73	0.458	-1	0.317
It is important to collect data on students' behavior.	3.63	0.5	3.80	0.414	-1.732	0.083
The BCP will help me develop/enhance my time management skills.	3.13	0.719	3.57	0.514	-1.508	0.132
The BCP will help me develop/enhance problem-solving skills.	3.19	0.75	3.47	0.640	-0.832	0.405
The BCP will help me develop/enhance my collaboration skills.	3.19	0.75	3.40	0.632	-0.577	0.564
The BCP will help me develop/enhance my communication skills.	3.19	0.75	3.53	0.516	-1.155	0.248
The BCP will help me develop/enhance critical-thinking skills.	3.19	0.75	3.60	0.507	-1.387	0.166

* $P <.05$

The pre-and post-assessment showed positive increases in each statement and significant increases in seven statements, indicating that participating in this course gave participants a better knowledge about ABA, FBAs, BIPS, and classroom management strategies. In addition, positive increases indicate that by participating in this course, participants felt more comfortable conducting an FBA, developing a BIP, implementing a BIP, designing data collection procedures to address academic concerns, designing data collection procedures to address behavior concerns, and collecting data. The positive increases indicated that they are more confident in implementing classroom management strategies and recognized the importance of collecting academic and behavioral data. Moreover, they also indicated that the BCP implemented using PBL helped them develop or enhance professional work skills, including time management, problem-solving, collaboration, and critical-thinking skills.

With positive increases in their knowledge, their confidence level, and their perceptions, Wilcoxon Signed Ranks Test showed that students demonstrated a significant increase in the following seven statements: I am familiar with Applied Behavior Analysis, with $Z = -2.121$, $p =0.034$, this indicated participants gained knowledge about ABA vocabulary, principles, and strategies.   I am familiar with Functional Behavior Assessments (FBA), with $Z = -2.309$, $p =0.021$, and I am familiar with Behavior Intervention Plans (BIP), with $Z = -2.546$, $p =0.011$, which demonstrated participants gained knowledge about the purpose and components of FBAs and BIPs. I am comfortable conducting an FBA, with $Z = -2.332$, $p =0.02$; this indicates students gained skills through completing the BCP that enabled them to become more comfortable assessing student behavior and developing a hypothesis about the possible function of the behavior. I am comfortable developing a BIP, with $Z = -2.165$, $p =0.03$, demonstrating that participants gained skills that enabled them to develop an intervention plan to increase a target behavior or replacement behavior.   I am comfortable designing a data collection procedure to address behavior concerns with $Z = -2.373$, $p =0.018$, and I am comfortable collecting data in regard to students' academic performance, with $Z = -2.226$, $p =0.026$. This indicated that participants gained knowledge and skills about data collection systems and methods that enabled them to become more comfortable designing data collection systems.

Discussion

Classroom management is ranked as one of the most prevalent difficulties classroom teachers face, often leading to teacher stress and burnout. The US Surgeon General acknowledged that three decades of studies have shown that using behavioral techniques, such as ABA, effectively decreases undesirable conduct and enhances communication, education, and suitable social behavior (Satcher, 1999). In addition, ABA strategies have demonstrated positive results in a variety of settings ranging from individual interventions to school-wide settings and with a variety of age and ability levels (Bowman-Perrott et al., 2015; Briesch & Briesch, 2016; Didden et al., 1997; Horner & Sugai, 2015; Joseph et al., 2016; Kamps et al., 2011; Trump et al., 2018). Many preservice teachers are not exposed to ABA strategies during their college preparation programs. Therefore it is not unexpected that many teachers do not believe they are prepared to design and implement student intervention plans or manage classroom behavior (Coggshall et at., 2012; Giallo & Little, 2003; Meister & Melnick, 2003; Melnick & Meister, 2008; O'Neil & Stephenson, 2012; Veenman, 1984).

The current study examined the use of PBL to increase participants' ABA knowledge of ABA strategies and increase professional skills, and the results showed that participants significantly increased their familiarity with ABA principles, ABA strategies, ABA skills, FBAs, and BIPs after completing the BCP.   This finding was like a previous study conducted by Smyth et al. (2019), who employed professional development to increase teachers' knowledge and enhance their attitudes towards ABA. In addition, results from this study indicate that participants felt they had gained knowledge and understanding of these concepts after completing the BCP. This indicates that participants could define, list, describe, classify, and explain these concepts.

Given the fact that BCP participants had to determine the function of the target behavior, design a data collection system, implement an intervention, collect data, analyze data, address intervention modifications, and plan for self-management or generalization of the target behavior or

replacement behavior, results of this study add to previous research illustrating teachers and preservice teachers can learn to successfully implement ABA strategies and interventions (Pitts et al., 2019; Rublow et al., 2018; Grey et al., 2005; Mrachko et al., 2017).

Although results did not show statistically significant gains in PBL skills, such as time management, problem-solving, collaboration, communication, and critical thinking skills, the findings show gains for each survey item addressing this research question. This adds to previous research findings that PBL supports and enhances student learning (Dag et al., 2017; Tsybulsky & Muchnik-Rozanov, 2019; Wilhelm et al., 2008; Alrajeh, 2021; Kokotsaki et al., 2016). Specifically, the results of this study show that participants reported completing the BCP through a PBL format helped develop or enhance time management, problem-solving, collaboration, and communication skills. These skills are important professional work skills and will enable participants to become successful teachers. This research adds to previous research illustrating that PBL prepares participants for everyday challenges (Häkkinen et al., 2017; Kokotsaki et al., 2016; Larmer & Mergendoller, 2015).

The Council for Exceptional Children (CEC) developed twenty-two High-Level Practices (HLPs) that capture the core principles of successful special education practices and identify methods to support special education candidates (CEC, 2017). This research project addressed HLPs in each of the four domains: collaboration, assessment, social/emotional/behavioral, and instruction domains. In the collaboration domain, results showed that participants were able to collaborate with peer groups to increase BCP project success. When considering the assessment domain, participants successfully interpreted and communicated data to design and implement a program and used assessment data to analyze instructional practice and make modifications when needed. Regarding the social/emotional/behavioral domain, participants provided positive feedback to guide learning and felt more comfortable conducting an FBA and developing a BIP. Finally, relating to the instruction domain, participants developed a learning objective, designed an intervention to address the objective, and provided self-management and generalization strategies.

Limitations and Recommendations

There are some limitations in this study. One limitation is that the ABA course was only offered online in an eight-week semester format. The ABA course could be offered in a face-to-face format in which students worked on their BCP in small groups during class time. Working in a face-to-face format could possibly increase participation and enhance BCPs and the PBL aspects of the project. Increasing participation and improving the PBL aspects could have a greater impact on student learning, improve participants' knowledge of ABA strategies, and increase the likelihood of developing and implementing ABA interventions. In addition, the course was offered in a condensed eight-week semester. While all components of the BCP were completed, it is possible that participants could have spent more time on certain aspects of the BCP, such as baseline data collection and intervention implementation during a long semester. Students may gain more knowledge and practice on certain aspects of the BCP during a long semester. Future research could focus on implementing this type of project online and face-to-face and comparing the results. Future research could also focus on incorporating this type of project during a longer time frame, such as a sixteen-week semester.

Although participants reported gaining knowledge, being more familiar with ABA principles, being more comfortable conducting FBAs, implementing BIPs, and designing and implementing data collection systems, this research study did not measure generalization efforts. Gaining knowledge and familiarity with an academic or behavioral strategy does not necessarily lead to the successful implementation of the strategy (Brownlee et al., 2009). Future research should track the actual implementation of strategies based on ABA in classrooms.

Lastly, there was a small group of participants. Therefore, the results of this study should not be generalized to a large population. To increase the research scope, more participants may be included in a future study. This type of project could also be implemented and researched in a professional development format conducted by Board Certified Behavior Analysts and School Psychologists for in-service teachers.

Conclusions

This study showed that ABA strategies can help pre-service teachers implement effective intervention strategies.

By completing a BCP focused on ABA strategies, participants reported significant gains in familiarity with ABA, FBAs, and BIPs. Participants reported being significantly more comfortable conducting FBAs and BIPS and designing and implementing data collection procedures. Future research should concentrate on implementing ABA projects and professional development in different modalities and within different time frames. In addition, future research should include tracking and strategies for generalization and implementation of ABA strategies within classrooms. This study illustrated that pre-service teachers could become more familiar with ABA and become more comfortable implementing classroom management strategies.

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Appendix A

Knox: Racing Towards Independence

Student Name
Professor Name
Course
Date

Operational Definition: As soon as Knox states he is thirsty he will independently: go to the kitchen, obtain a cup, place the cup in the refrigerator water dispenser space, and fill the cup with water with no more than one verbal prompt.

Recording Method: I have used an event recording system where each trial is marked as successful or unsuccessful. If Knox can successfully complete 10 out of 15 trial independently, he will meet his goal for this project.

🏁 **Knox** 🏁

Knox is a hot wheel-loving four-year-old who tends to rely on his parents for basic needs, despite being physically capable.

He was diagnosed with ASD and a speech impairment at the age of three. Despite his diagnosis, Knox is making huge progress with his IEP goals and has surpassed all goals for the PreK level.

The reason for this project is to move Knox towards more independence. He knows how to request water, and he knows where to get it, but lacks the confidence and skills to get it for himself. The observations and interventions will take place in his home between the hours of 4pm-9pm.

BASELINE DATA

	11/4	11/5	11/6	11/7	11/8	11/9	11/10	11/12	11/13	11/14	11/15	11/16	11/17
	7	7	7	7	7	7	7	7	7	7	7	7	7
	6	6	6	6	6	6	6	6	6	6	6	6	6
	5	5	5	5	5	5	5	5	5	5	5	5	5
	4	4	4	4	4	4	4	4	4	4	4	4	4
	3	3	3	3	3	3	3	3	3	3	3	3	3
	2	2	2	2	2	2	2	2	2	2	2	2	2
	1	1	1	1	1	1	1	1	1	1	1	1	1

Legend
Successful   O
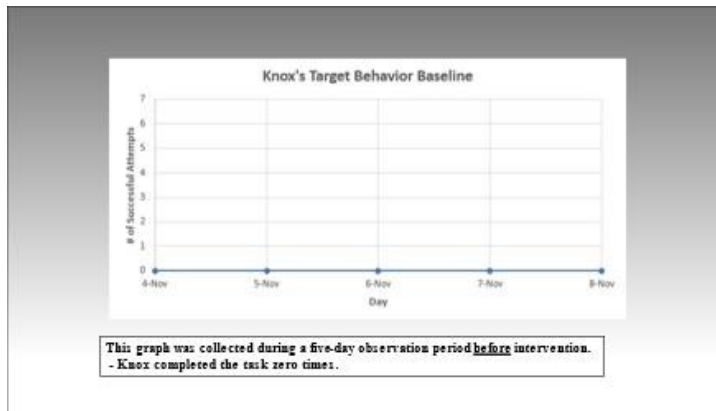Unsuccessful   /

EVENT RECORDING

This data collection system uses event recording with the use of a trial-by-trial form. A green circle is placed around the number if the task is completed according to the criteria. A red slash is placed through the number if attempt was made but criteria not met.


Behavioral Objective

While at home and with only one verbal prompt, Knox will take his cup to the refrigerator and fill it with water, without assistance, with 100% accuracy in 10 out of 15 trials.

Knox's Target Behavior Baseline

(Graph: # of Successful Attempts vs. Day, 4-Nov through 8-Nov, all values at 0)

This graph was collected during a five-day observation period before intervention.
- Knox completed the task zero times.

Baseline Narrative

During the baseline observations, recorded between November 4th and November 8th, Knox completed the target behavior (obtaining a cup of water independently) a total of zero times. This reflects the behavior before any interventions.

Intervention Graph

| Baseline | Verbal Praise | Verbal Praise & Token Reinforcer |
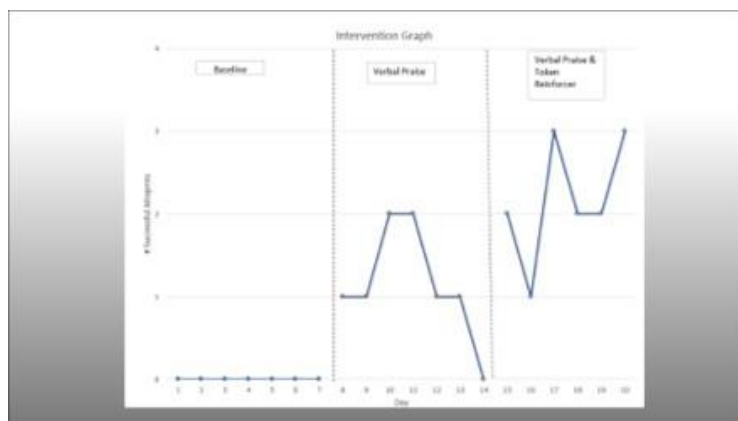
Intervention Method

The first step was to build up Knox's confidence by conducting a task analysis. Knox and I reviewed the steps (requesting water, walking to the kitchen, obtaining a cup, pressing the cup to the dispenser, counting to ten), and then I modeled the behavior while verbally stating each step. Knox "practiced" the full task until he was able to complete each step independently.

Knox began to show immediate progress!

Intervention Narrative

The graph above represents data from the baseline, intervention, and two types of reinforcements. The first phase of the graph is Knox's baseline before intervention. The second phase represents Knox's successful attempts after intervention, and with the use of verbal praise as reinforcement. The third represents Knox's successful attempts after the intervention with verbal praise, plus the addition of token reinforcement. The intervention with verbal praise and a token reinforcer was most effective.

Reinforcement Summary

Two types of reinforcement were used during this project: Verbal praise and token reinforcers.

Verbal praise was given each time Knox completed the task. We would sing the "I did it, I did it!" song, which is his favorite.

In addition, a token economy was implemented with the use of a visual chart. Knox had a Hot Wheels racetrack chart that tracked his successful attempts. He would place a checkmark in the appropriate space each time the task was completed, which got him one step closer to receiving "First Place." Once he had checkmarks on all the spaces, he received a brand-new Hot Wheels car!

Prompt Summary

Only one type of prompt was given throughout this project. When Knox requested water I would tell him, "Knox is a big boy and needs to get it himself." After eleven days, Knox no longer needed the prompt and would initiate the task on his own.

Changes Made

One week after the intervention, Knox was less enthusiastic about the "I did it!" song after completing the task. On day eight, he refused to even try and had a meltdown. Knox tends to become bored with unchallenging things, which causes him to act out, so I decided to shake things up with an incentive (token reinforcement). Because of his infatuation with all-things-Hot Wheels, I asked him if he wanted to play a racing game. . . of course, he said yes! Placing the checkmarks on his racetrack and knowing he would get a new Hot Wheel car reignited his enthusiasm and motivation to complete the task.

Self-Management/Generalization

After Knox's progress, we discussed this project with his Pre-K teacher in hopes that he would demonstrate independence in the classroom as well. Instead of the refrigerator, he would be required to fill up his cup from the designated water fountain while at school. His teacher showed him where it was only one time before he began to go on his own each time he announced he was thirsty. Success!

Journal Article 2

Journal 2

The purpose of this study was to help transition young classroom children to accept vocal GCR (generalized conditioned reinforcers) in lieu of tangible or edible GCRs. GCRs are typically paired with previously established reinforces and include items such as tokens. The tokens are earned and accumulated in a token economy system, then exchanged for a preferred reinforcer. The reasoning behind discontinuing the token system is that it is not appropriate in all settings. A non-tangible consequence (vocal) could be an effective alternative instead of singling out a student or disrupting class.

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Journal Article 1

Article #1.docx

Due to a shift towards inclusion classrooms, there is a need for a more naturalistic approach, embedded teaching. During a recent study, a procedure termed BWAT was used to increase independent skills. The reason for this project is to replicate the least-to-most prompting and praise procedure to determine the effects of an embedded lesson. Studies have shown the effectiveness of learning behavioral strategies to teach children with disabilities.

The reason for this study was to show how independence increased for students with Autism using embedded teaching procedures. Although more research on BWAT is needed, the methods showed effectiveness in promoting independence for persons with disabilities. The information collected was not influenced by feedback from staff members. Because of this, the effects of the strategy were viewed independently to depict results accurately.

Toelken, S., & Miltenberger, R. G. (2012). Increasing Independence among Children Diagnosed with Autism Using a Brief Embedded Teaching Strategy. *Behavioral Interventions, 27*(2), 93–104. https://doi.org/10.1002/bin.337

Reflection

I believe that the project was a success and Knox has maintained his target behaviors. One thing I would change the use of a token economy (we are currently in the process of fading). Knox has come to believe that he should have a "racetrack" chart for everything he does, even though they are well-established tasks (i.e., cleaning up toys, taking a bath, brushing his teeth). This system, although highly effective, seemed to backfire since his fixation is on receiving Hot Wheels cars.

Appendix B

Pre-Assessment Project Survey

The definitions of strongly disagree, disagree, agree, and strongly agree are listed in the following. Please use these options to answer the multiple-choice questions in this survey.

Strongly Disagree means:
- you do not think it is important at all;
- you have not heard of the vocabulary and you have no understanding of it;
- you have not heard of any of the strategies and you are not able to conduct, develop or use them with assistance

Disagree means:
- you do not think it is important;
- you may have only heard the vocabulary but you have no understanding of it;
- you may have heard/read about the strategy(ies) but are not able to conduct, develop or use any of the strategies with assistance

Agree means:
- you think it is important;
- you are familiar with the vocabulary; you have some understanding of vocabulary;
- you can conduct or use the strategies with assistance

Strong Agree means:
- you think it is very important
- you have an in-depth understanding of the vocabulary; you understand the vocabulary and use it fluently;
- you are able to conduct, develop or use the strategies independently

1. I am familiar with Applied Behavior Analysis.
- Strongly disagree
- Disagree
- Agree
- Strongly agree

2. I am familiar with Functional Behavior Assessments (FBA)?
- Strongly Disagree
- Disagree
- Agree
- Strongly Agree

3. I am comfortable conducting a FBA?
- Strongly Disagree
- Disagree
- Agree
- Strongly Agree

4. I am familiar with Behavior Intervention Plans (BIP)?
- Strongly Disagree
- Disagree
- Agree
- Strongly Agree

5. I am comfortable developing a BIP?
- Strongly Disagree
- Disagree
- Agree
- Strongly Agree

6. I am comfortable implementing a BIP?
- Strongly Disagree
- Disagree
- Agree
- Strongly Agree

7. I am familiar with classroom management strategies?
- Strongly Disagree
- Disagree
- Agree
- Strongly Agree

8. I am confident implementing classroom management strategies?
- Strongly Disagree
- Disagree
- Agree
- Strongly Agree

9. I am comfortable designing a data collection procedure to address academic concerns?
   - Strongly Disagree
   - Disagree
   - Agree
   - Strongly Agree

10. I am comfortable designing a data collection procedure to address behavior concerns?
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

11. I am comfortable collecting data in regards to student's academic performance?
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

12. I am comfortable collecting data in regards to student behavior?
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

13. It is important to collect data on student's academic performance.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

14. It is important to collect data on student's behavior.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

15. The BCP will help me develop/enhance time management skills.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

16. The BCP will help me develop/enhance problem-solving skills.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

17. The BCP will help me develop/enhance collaboration skills.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

18. The BCP will help me develop/enhance communication skills.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

19. The BCP will help me develop/enhance critical-thinking skills.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree