Education and Training in Autism and Developmental Disabilities, 2015, 50(3), 356–368

Using Science Inquiry Methods to Promote Self-Determination and Problem-Solving Skills for Students with Moderate Intellectual Disability

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Abstract: This study investigated the use of guided science inquiry methods with self-monitoring checklists to support problem-solving for students and increased autonomy during science instruction for students with moderate intellectual disability. Three students with moderate intellectual disability were supported in not only accessing the general curriculum science standards, but also building self-determination skills when applying inquiry problem-solving skills to functional daily applications. A multiple probe across students design was used to establish a functional relationship between the percent of inquiry problem-solving steps performed independently and the use of self-monitoring checklists during traditional and functional-based science activities. Results indicated that following intervention students increased their autonomy in completing inquiry problem-solving activities linked to science content. In addition, students were able to successfully generalize these skills when presented with novel problem-solving tasks related to daily living situations.

A growing debate exists among academics in special education as to what should be taught to students with an intellectual disability enrolled in a functional curriculum (Ayers, Lowery, Douglas, & Sievers, 2011; Courtade, Spooner, Browder, & Jimenez, 2012). The Individuals with Disabilities Education Act (IDEA, 2004) emphasized an individualized curriculum leading to meaningful post-school outcomes and focused on daily living skills (Brown et al., 1979). Yet, No Child Left Behind (NCLB, 2001) placed a larger focus on academic content and assessments (Ayers et al., 2011) leading to a divide among educators in providing access to academic content for students enrolled in a functional curriculum (Miller, Krockover, & Doughty, 2013). Students who participate in a functional curriculum, typically those with an intellectual disability remain part of the accountability measures of NCLB (Ayers et al., 2011; Browder, Jimenez, & Trela, 2012; Courtade et al., 2012; NCLB, 2001). While their curriculum is not limited to grade-level standards, it must be linked to educational standards (Ayers et al., 2011; Browder et al., 2012). Yet many educators lack effective interventions to teach academic content in meaningful and functional ways (Miller, 2012; Miller et al., 2013).

Instructional methods for teaching science content to individuals with intellectual disability are an area in which little research exists. Yet one instructional method, scientific inquiry, is important for developing critical life skills. The ability to acquire and apply inquiry methods to problem solving holds potential for students with moderate intellectual disability in both academic and functional contexts (Miller, 2012). Students with an intellectual disability can acquire academic content (vocabulary and content knowledge); however, research has yet to provide evidence supporting the acquisition of content area academic *skills* (i.e., problem-solving, argumentation, and communication) for these students. Evidence-based practices such as explicit instruction, peer-mediation, time delay, and task analysis were successful in teaching students with intellectual disability content in academic areas such as language arts (Browder, Wake-

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TABLE 1

Participant Characteristics

Student	*Age*	*Ethnicity*	*Primary Disability*	*Secondary Disability*
Steve	15	Caucasian	Moderate Intellectual Disability	Speech Language Impairment, Other Health Impairment
Kourtney	14	Hispanic	Moderate Intellectual Disability	Speech Language Impairment
Becca	19	Caucasian	Down Syndrome	Moderate Intellectual Disability, Speech Language Impairment, Other Health Impairment

man, Spooner, Ahlgrim-Delzell, & Algozzine, 2006), mathematics (Browder et al., 2012), and science (Courtade, Spooner, & Browder, 2007). However, as studies focused on these content areas, the area of science interventions remains sparse, with limited studies relating to content standards and science as inquiry (Jimenez, Browder, Spooner, & DiBiase 2012).

Studies examining science content included direct or systematic instruction, measured acquisition in science content (Spooner, Knight, Browder, Jimenez, & Warren, 2011) and science inquiry (Miller et al., 2013; Miller, 2012). These content areas and skills are supported by the Next Generation Science Standards (Achieve Inc., 2013) that focus on *performance* expectations and require students to demonstrate concepts across ideas. Students are expected to use logic and world experiences to recognize similarities among the core ideas in science and engineering (Achieve Inc., 2013). Emerging research demonstrates the potential of inquiry methods for students with a moderate intellectual disability as they investigate their world (Miller et al., 2013; Miller, 2012). For example Miller et al. (2013) used guided inquiry methods and electronic notebooks on tablet devices to work with students with moderate intellectual disability to teach science lessons related to color blending and mealworms. Students were able to independently engage in the 5E inquiry process model (Bybee et al., 2006) and communicate their learning through both traditional and e-note booking methods. The skills needed to generate questions about the world, solve problems, and support and communicate ideas are considered self-determination skills and valuable for students with an intellectual disability (Wehmeyer, Palmer, Agran, Mithaug, & Martin, 2000).

The purpose of this study was to examine the effectiveness of a self-monitoring checklist when used by students with a moderate intellectual disability enrolled in a functional curriculum to increase their autonomy when completing inquiry problem-solving activities linked to science content. The effectiveness of the self-monitoring checklist was also examined to determine student's ability to independently generalize problem solving when applied to daily living situations.

Method

Participants

Participants included three secondary students diagnosed with a moderate intellectual disability and enrolled in a functional curriculum. Three students were recruited from a suburban Midwestern high school and were between the ages of 14 and 19. Each met the following participation criteria: a) had primary diagnosis of a moderate intellectual disability, b) consent from parent or guardian was provided, c) obtained assent from student, d) a lack of sensory disabilities, e) an ability to follow a 3-step directive, and f) the ability to communicate verbally (see Table 1).

Kourtney was a Hispanic-Caucasian, 14 year-old female in the tenth grade. Her primary diagnosis was a moderate intellectual disability with a secondary disability of speech and language impairment. She received special education services in a self-contained classroom where she followed a functional curriculum consisting of using functional sight words, basic prompting levels, and a token economy. She struggled to self-monitor and express her emotions when she felt uncomfortable in social situations and frequently smiled and giggled as a coping mechanism. She would often fall to the floor weeping and would throw things when she experienced unwanted demands. She struggled to stay focused during unstructured classroom time and was easily distracted by others. Kourtney's previously used visual aids to prompt responses to questions and was successful using a picture journal when in the community and grocery shopping.

Becca was a Caucasian, 19 year-old female in the eleventh grade. Her primary diagnosis was Down syndrome with a moderate intellectual disability and secondary diagnoses of speech language impairment and congenital heart disease. She received instruction in a self-contained resource setting for mathematics and English Language Arts (ELA). During ELA, she was able to work on a modified curriculum focused vocabulary development and writing with picture supports. Her teacher reported that Becca could be extremely emotional and struggled to express her emotions to others in appropriate ways. She was able to phonetically write short sentences and sound out words as well as read functional sight words.

Steve was a Caucasian 15 year-old male in the tenth grade. His primary diagnosis was a moderate intellectual disability with a secondary diagnosis of speech language impairment and other heath impairment. Steve was able to read sight words and write simple sentences phonetically. He could add single digits and subtract with the use of manipulatives. Current IEP goals for Steve included reading fast food words, self-monitoring performance, time management, and increasing time-on task. He participated in large group speech sessions that focused on functional tasks such as weather, stranger danger, and dressing. According to his teacher he contributed to discussions but was easily distracted and struggled to stay on topic.

Setting

The study took place in student's regular school setting in a small private classroom located down the hall from the students regular self-contained classroom, which was used daily for small group instruction. This room was used mathematics and ELA instruction. The room contained a large conference-style white board that opened to reveal two smaller white boards inside each door. On the opposite wall were windows facing the street. The room's center contained a long rectangular table surrounded by six chairs. The far end of the room housed a counter that held teaching materials. On the opposing wall was a computer and additional instructional materials.

Dependent and Independent Variables

The dependent variable in this study was student's percent of independence when completing inquiry problem-solving steps and the percent of guided science inquiry steps completed without the inclusion of the self-monitoring checklist steps. The independent variables include both guided science inquiry and self-monitoring checklists. A task analysis for inquiry investigations was modified from the established 5E model and included: engagement, exploration, explanation, elaboration, and evaluation (Bybee et al., 2006). The modified task analysis steps were placed on self-monitoring checklists on a self-operated iPad device.

Materials

Apple iPad® mini. This device was used to display a self-monitoring checklist and was 7.9" × 7.2m in size, weighing .68lbs, and containing a multi-touch 1080p high definition screen display. It held a battery life of up to 10 hours and a dual-core processor A5 chip that held 32GB of memory for $429 (Apple Inc., 2013).

A *Self-Monitoring Checklist Application* on *Choiceworks* by Bee Visual LLC (2013) was used to store self-monitoring prompts for the inquiry problem-solving tasks during intervention. *Choiceworks* is a daily routine board maker and contains prompting tools to assist users through daily tasks. Checklists, schedule boards, activity timers, and a communication board can be developed using this system. The software was purchased on iTunes for $4.99 and allows users to create and share tasks and schedules across devices, print boards, and to monitor progress. Audio and picture captions may be added to task lists. Once a checklist is developed, icons are placed down the left hand column. The user may listen to the audio prompt prior to beginning the task sequence. Once a step is completed, the user can use a finger to slide the icon across the iPad screen to an empty box on the right. If done correctly, a large green check appears over the icon and the user hears "all done" (see Figure 1).

Design

A multiple probe across students design was used to establish a functional relationship between the percent of inquiry problem-solving steps performed independently and the use of self-monitoring checklists. The multiple probe design was selected to expose students to fewer sessions in baseline and reduce the possibility of carryover effects due to prolonged guided science inquiry instruction during baseline (Gast & Ledford, 2010). To strengthen the design, a generalization and maintenance phase was conducted (Kennedy, 2005). All students began baseline simultaneously. Baseline probes were staggered to introduce intervention at different points in time to establish a multiple baseline, with the last two points successive prior to intervention. Intervention was introduced once the previous student reached a stable pattern in intervention for three or more sessions, reached criterion of 80%, or completed four sessions in intervention. Stability was considered when 80% of the data fell on or within a 20% range (Gast & Spriggs, 2010).

Data Collection

Event recording was used to record the percent of task analysis steps each student performed independently during science problem-solving activities and daily functional problem-solving activities. By considering the percent of independence across students and conditions, the efficacy of self-monitoring checklists and the validity of guided inquiry problem-solving methods could be demonstrated. Since the questions and tasks required critical thinking, a five-second-wait time before prompting was selected to allow students time to think about the question and respond. For the inquiry tasks analysis, initiation of a step was recorded as independent. Guidance by the facilitator, implemented after initiation to further incorrect inquiry steps, was recorded as dependent.

Procedure

Baseline. During baseline, students were provided five-guided inquiry lessons connected to the national science standards (NRC, 1996) that included a specific integrated functional skill based on the each student's IEP (e.g., cleaning up the dishes afterwards). Lesson materials were presented to students along with the science topic. Students were then able to explore the materials (i.e., touch and smell items, ask questions) they would need to complete the task. During this phase, students were asked to perform the functional skill such as measuring materials and cleaning the workspace. During the lesson, the steps of inquiry problem solving the student independently performed were recorded. A system of least prompts was used following a five-second-wait time before providing any prompt to initiate one of the 5E steps (i.e., a verbal prompt "What *questions?*"). Inquiry task-analysis steps were: a) ask a question, b) make and state observations, c) create a plan for a solution, d) test solution, and e) explain results.

To avoid leading questions that link to subsequent task analysis steps and prevent unintentional prompting of the next inquiry step, guided discussions of content were only conducted in step 5. For example, in natural guided inquiry conversation the facilitator would likely follow a student observation asking, " Why do you think that is?" which prompts step 5, *Explain.* Therefore, the facilitator would not engage in building content discussions until after they demonstrated independence in step or a need for a prompt in step 5. Baseline data were reported as the number of task analysis steps initiated independently by the student.

Training. Following baseline, a training phase was conducted to teach students the five steps of problem solving through inquiry, the iPad® picture symbols used, as well as how to use the iPad®. Three training sessions over a

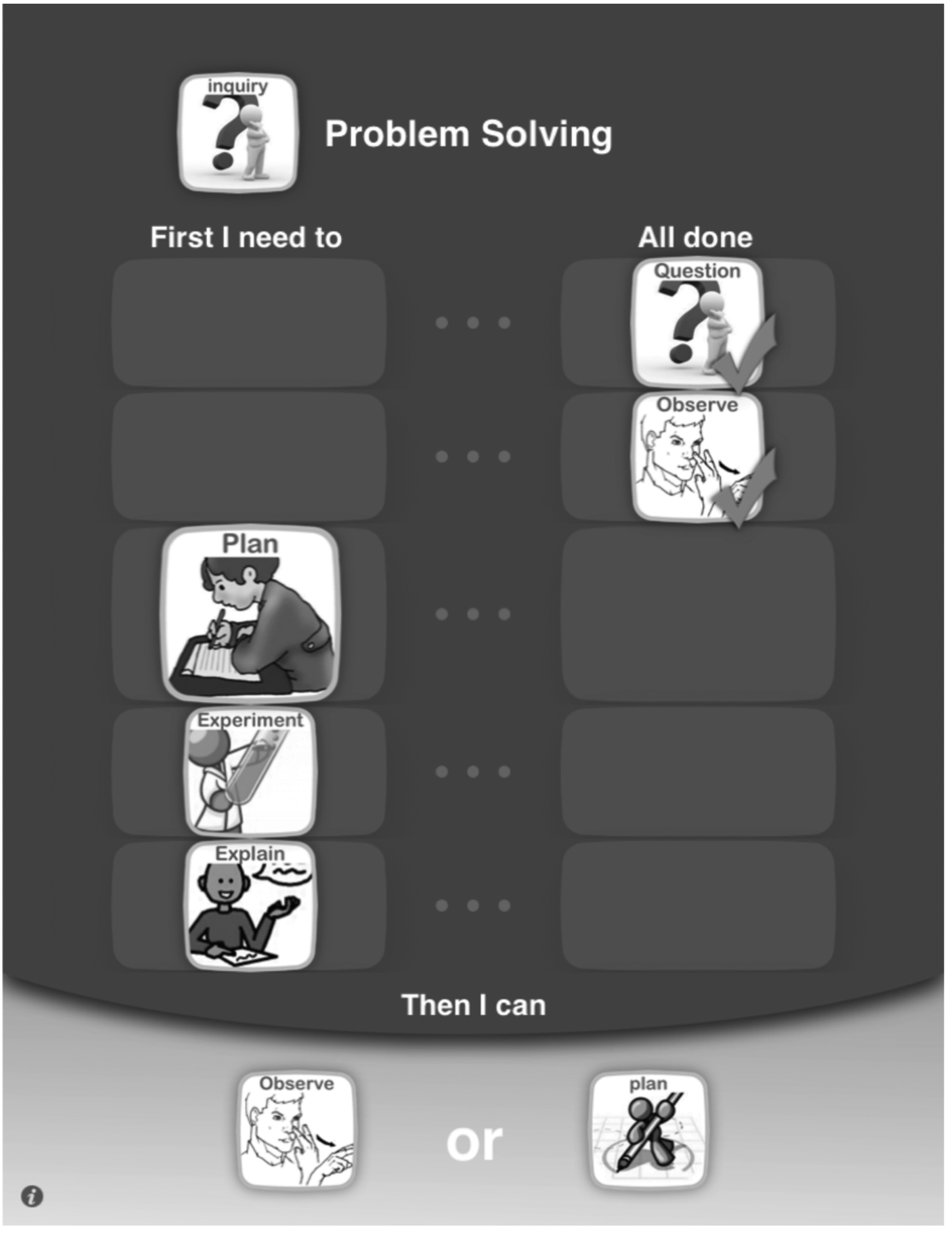

Figure 1. Inquiry task analysis checklist.

two-week period for 20 minutes each were conducted on how to use the iPad® including instruction on operating the hardware. Operating instruction such as turning the device on and off, making swiping motions to move icons in the application, control the volume, and exit the application and return to the main screen were included. During training, students practiced how to turn the iPad® on and off, swipe across the screen to access different screens, use the volume, as well as navigate the checklist application. A task analysis was used during the training phases for student's use of the inquiry checklist application. Students were required to reach 100% independence in operating the checklist two out of three times. The five steps of inquiry (Observe, Question, Plan, Experiment, Explain; Bybee et al., 2006) and their meanings were introduced in mini lessons. Students were shown images of the inquiry step icons and words (one per page) and the concept of being a scientist and completing the steps to solve problems. Students were then shown the icon pages, the words were read aloud, and each student read it back while pointing to the corresponding icon. After reviewing each icon, their meanings and examples, students were presented with a short story problem (e.g., Sarah came home from school and noticed her dog Buddy wasn't in his usual location in the backyard). The student discussed the problem and possible solutions. Students then viewed the self-monitoring checklist on the iPads® and guided through its use with the story problem. The student the completed a second short story problem with prompts to "use your checklist list to solve the problem."

Intervention. A least four guided inquiry science lessons were taught during intervention. Four sessions were selected as a minimum to show any pattern or changes from baseline to intervention and provide students time to acquire inquiry methods. Students were provided with iPads® to self-monitor and track their progress in the inquiry problem-solving steps. Intervention lasted one week. The facilitator placed lesson-related materials on the table that the student was free to explore. The facilitator then introduced the topic and guiding question to the student and prompted him or her to use the checklist as each explored the materials needed to gain further explanation of the concept. Using a system of least prompts, the facilitator prompted the students to use the checklist as they problem-solved and implemented guided inquiry methods. Each student was asked to perform the functional skill integrated into the given lesson. Inquiry steps initiated independently by the student were recorded. The inquiry problem-solving task analysis was taught and assessed using the system of least prompts. The task-analysis for inquiry skills were constant across students, a) asking a question, b) making and stating observations, c) creating a plan for a solution, d) testing their solution, and e) explaining their results.

Generalization. Students used the iPad® self-monitoring checklist intervention to support inquiry problem solving in novel situations related to functional daily situations (e.g., cleaning a stain, plugging a hole in a cup). The inquiry problem-solving situations/ lessons took place in their school site. Students were presented with materials and a question or scenario related to a functional daily situation and used the self-monitoring checklist to follow the inquiry problem-solving task analysis steps to problem solve. If students didn't initiate use of the self-monitoring checklist, they were prompted and it was documented as a dependent step in the task analysis. Initiations of inquiry steps were counted as independent.

Maintenance. Two weeks following the generalization phase, the facilitator conducted two maintenance sessions to determine if students maintained what they problem solved using the self-monitoring checklists. One maintenance probe occurred during the intervention condition where students engaged in inquiry problem-solving skills during a science-focused lesson linked to content standards (slime recipes). A second maintenance probe occurred during the generalization condition where students engaged in inquiry problem solving of a daily functional task (reducing the weight of a container). Both maintenance conditions took place in the student's regular school setting in a separate classroom from their self-contained class.

Interobserver Agreement and Treatment Fidelity

Interobserver agreement (IOA) data were collected for each student during 40% of baseline, 41.66% of intervention, 41.66% of generalization, and 50% of maintenance sessions to determine the accuracy of the data collection procedures. IOA was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. Baseline IOA resulted in 94% agreement for Steve, for 92% for Kourtney, and 94% for Becca. Intervention IOA for Steve resulted in a mean of 89.5%, for Kourtney 94%, and for Becca 89.5%, with generalization phase IOA resulting in 92% for Steve, 92.25 % for Kourtney, and 96% for Becca. Maintenance phase, IOA was 94% for Steve, 98% for Kourtney, and 98% for Becca.

Treatment fidelity measures were recorded across conditions and participants. A second trained observer used specific checklists to determine the accuracy of procedural steps that were implemented. During intervention, fidelity measures were conducted for 25% of Steve and Kourtney's intervention phases, and 50% of Becca's intervention phase resulting in 100% for Steve and Kourtney and 93.75% for Becca (range 87.5%–100%). During generalization and maintenance sessions, treatment fidelity was conducted for 25% and 50% of sessions respectively resulting in 100% accuracy across both phases.

Results

Figures 2 and 3 illustrate the percentages of independent inquiry problem-solving task analysis steps performed were analyzed through visual analysis.

Steve. During baseline, the mean inquiry task analysis steps initiated independently was 49.53%. A generalization probe was conducted indicating 88.88% independence. During intervention, the mean level of independence was 83.33%,. The mean level of independent inquiry task analysis steps during the generalization phase was 93.75%. The split-middle method was used to analyze data trends. Results indicated increased independence across conditions (see Figure 3). The percent of all non-overlap of all pairs of data (PND) between baseline and intervention was 93.73%, PND between baseline and generalization was 93.73%, and between baseline and maintenance 90%.

Steven engaged in 12 independent questions, 23 independent observations, 20 independent plans, 33 independent experiments, and 23 independent explanations across all conditions. He made 5 independent questions in both baseline and intervention phases and two during generalization. He made 7 independent observations in baseline, four during intervention and 12 during generalization. His independent planning showed an upward trend across phases, increasing from three in baseline to eight in intervention and nine during generalization. The frequency of experiments showed a negative trend with 16 independent in baseline, 9 during intervention, and 8 in generalization. Steve's independent explanations of tasks were 5 in baseline, 5 during intervention, and 13 during generalization.

Kourtney. During baseline, the mean inquiry task analysis steps she initiated independently was 23.25%. During intervention the level of independent inquiry resulted in a mean of 58.54%. Kourtney's mean level of independent inquiry task analysis steps during generalization was 77.92%. The split-middle method was used to analyze the trend in data. Results indicated increased independence across conditions. NAP was conducted between baseline and all following phases. Between baseline and intervention, PND resulted in 91.67% baseline and generalization 100%, and baseline to maintenance phase, 100%. The specific steps in the task analysis were analyzed by frequency within and across conditions. Overall, Kourtney engaged in 8 independent questions, 24 independent observations, 14 independent plans, 18 independent experiments, and 9 independent explanations across all conditions. Her independent planning was consistent across phases with five in baseline, five in intervention, and four in generalization. Her data illustrated a negative trend in independent experimenting, with ten independent experiments in baseline, three during intervention, and five in generalization. Kourtney's independent explanations of tasks were zero in baseline, three in intervention and six during generalization.

Becca. During baseline, the mean inquiry task analysis steps initiated independently was 32.44%. During intervention, the mean level of independence was 95. 83%. Her mean level of independent inquiry task analysis steps during generalization was 96.88%,. The split-middle method was used to analyze the trend in data. Results indicated increased independence across conditions. PND was conducted resulting in 100% across baseline and all ex-

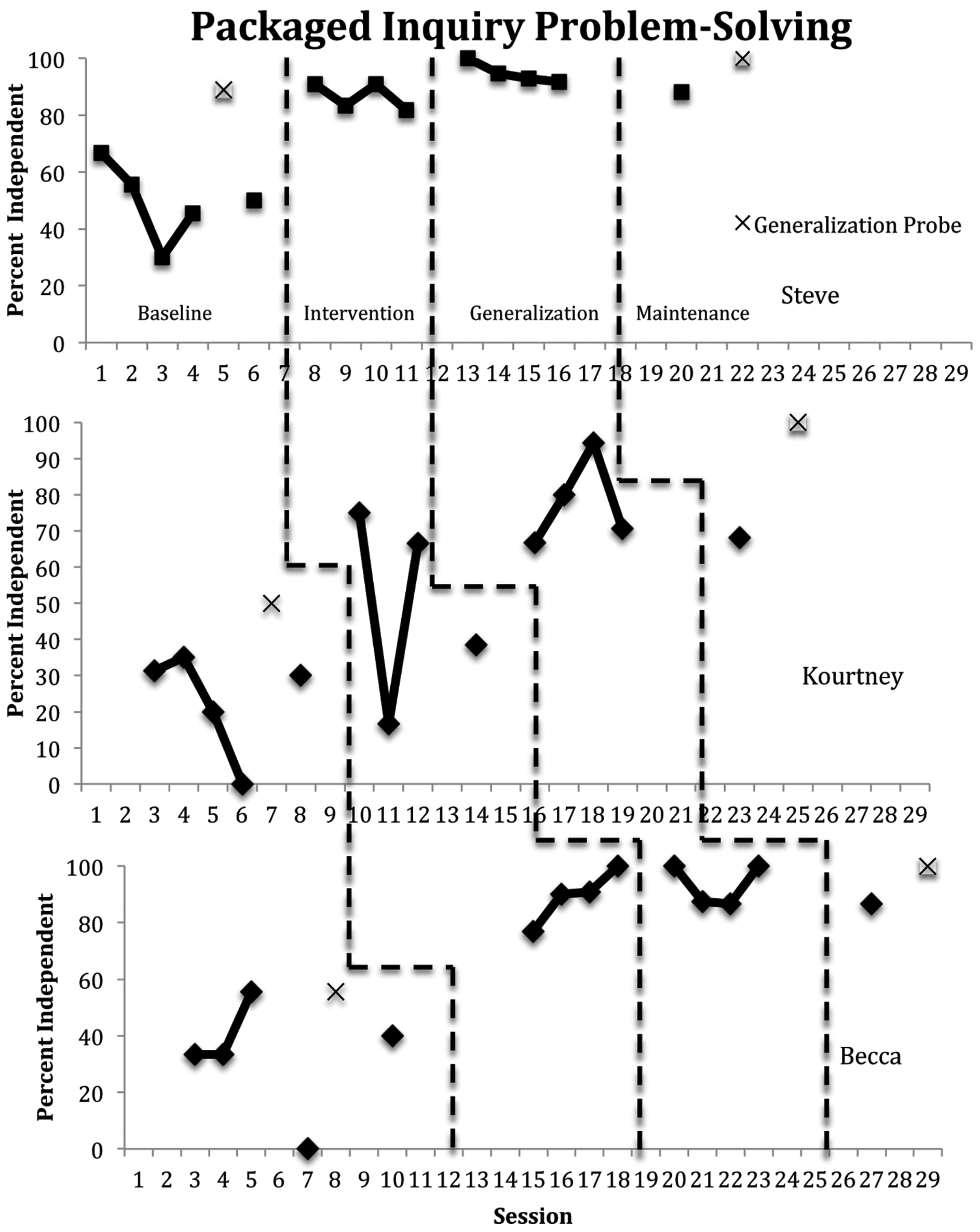

Figure 2. Percent independence in packaged inquiry problem solving across students.

perimental phases (intervention, generalization, and maintenance).

Overall, Becca engaged in seven independent questions, 15 independent observations, 17 independent plans, 11 independent experiments, and 10 independent explanations across all conditions. She made no independent questions in baseline, four independent questions during intervention and two during generalization. She made three independent observations during baseline, and six in both during intervention and generalization condi-

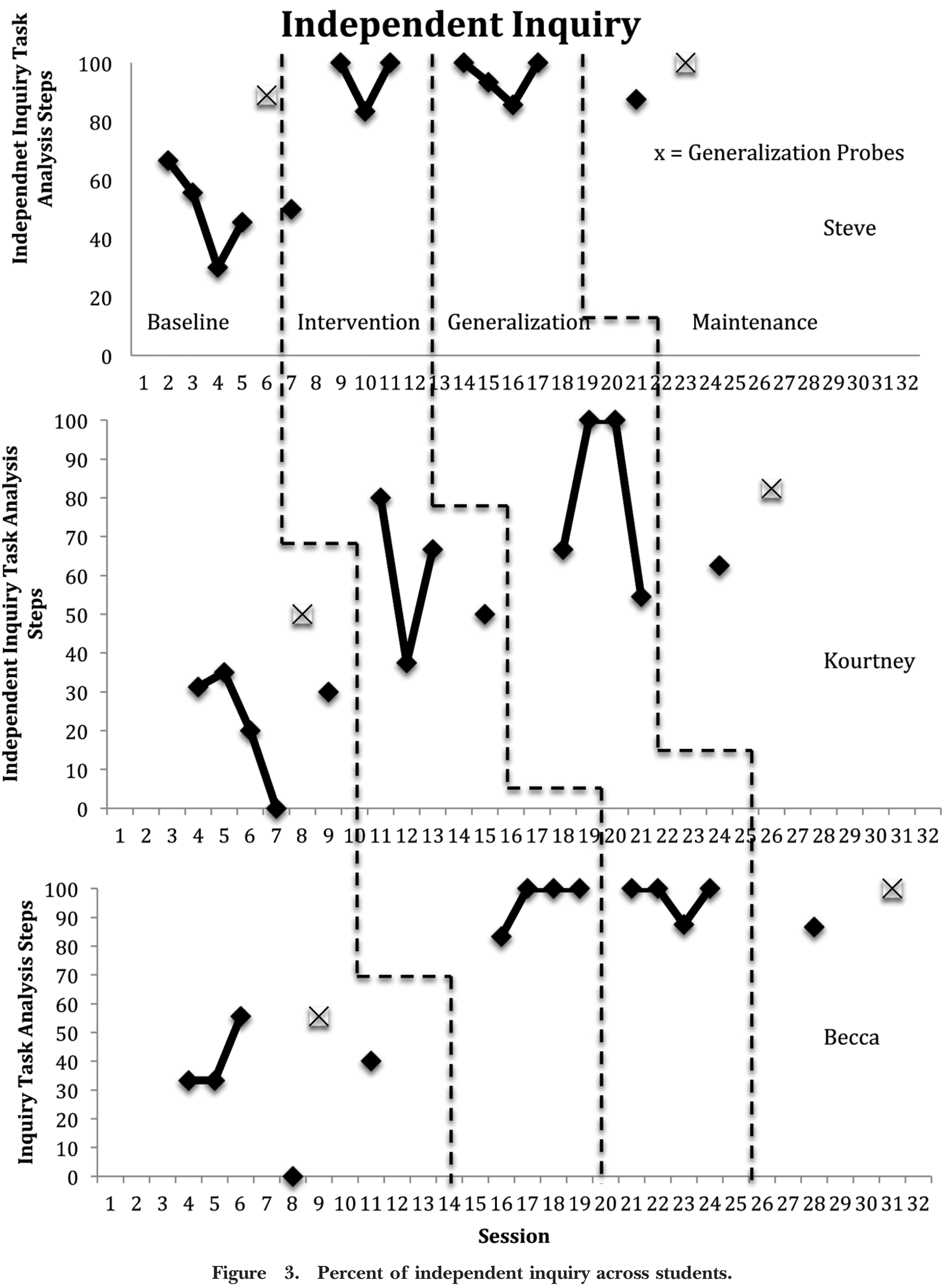

Figure 3. Percent of independent inquiry across students.

tions. She demonstrated independent planning five times in both baseline and intervention phases, and seven in generalization. She demonstrated independent experiments twice in baseline, five times during intervention, and four during generalization. Becca demonstrated one independent explanation in baseline, four in intervention, and five during generalization.

Social Validity

To determine the usefulness and social value of the intervention, students completed a questionnaire following completion of the study to obtain his or her feedback. Results indicated that students enjoyed the science activities and would like to continue doing them in their classroom. They indicated they learned from doing the lessons and two students indicated the self-monitoring checklist via the iPad helped them learn. All stated they enjoyed doing the lessons but indicated that they would prefer not to use the checklist. Steve and Kourtney indicated they would not want to use the checklist around peers. However, all indicated it would help them learn in other classes.

Discussion

Over the past decade, students with a moderate intellectual disability demonstrated their ability to acquire and perform traditional academic content after intense and repetitive direct instruction (Knight, Smith, Spooner, & Browder, 2012). However, this instruction and its outcome measures lacked functional outcomes. Instruction containing more performance outcomes and functional applications such as problem-solving and communication skills hold both cross-curricular and cross-environmental value and therefore, more meaningful instructional outcomes for students. Inquiry methods, believed to be best practice for science instruction and promote problem-solving, critical thinking, and the skills of self-determination for students in general education (Hammerman, 2006; NRC, 1996), are now sought as a methods for linking to academic instruction for students with a moderate intellectual disability (Agran, Cavin, Wehmeyer, & Palmer, 2006; Spooner et al., 2011). The purpose of this study was to investigate the effectiveness and generalization of guided inquiry methods when supported by self-monitoring checklists for students with moderate intellectual disability. To investigate the relationship between a) the level in which students problem-solve autonomously with self-directed prompting systems and b) their ability to generalize inquiry problem-solving with self-directed prompting systems, data validity across four conditions and three students was assessed for treatment effect. The results illustrate that all students increased their level of autonomy when completing inquiry problem-solving activities linked to science content and generalized those skills to daily living situations. More research is needed to confirm the casual relationship between the checklist and the positive trend in autonomy demonstrated in participants stated in the hypotheses.

When provided a self-monitoring checklist, students increased their level of autonomy when completing inquiry problem-solving activities linked to science content. Similar to the findings by Miller and Taber-Doughty (in press), the use of guided inquiry investigations when paired with a self-monitoring checklist resulted in increases in independence when problem-solving for both science content related tasks and functional tasks. Results indicated that when provided a self-monitoring checklist, students with a moderate intellectual disability not only generalized inquiry problem-solving steps to daily problem-solving situations, but also continued to show increases in their level of independence from intervention to generalization. All three students continued to trend upward with higher means in generalization compared to intervention and baseline.

Interventions using task analysis checklists and picture prompt systems for students with a moderate intellectual disability allow students to follow concrete steps in a sequence (Browder & Minarovic, 2000). The difference between traditional self-monitoring studies and the present study was that the tasks consisted of abstract problem-solving steps that were neither tangible nor concrete. Although the steps occurred each time, they were dynamic in that the student could engage in several observations and plans unlike traditional uses of checklists prompting systems where students follow a recipe or follow a list of sequential vocational tasks (Mechling & Ayers, 2012; Taber-Doughty, Miller, Shurr, & Wiles, 2013). The icons remained constant with the steps to problem-solving tasks across sessions. However, the actual performance task was much more complex, requiring critical thinking skills, novel activities each session, and new application of the problem-solving task-analysis. In this study, students never applied the intervention to the same activity more than once, but rather applied the self-monitoring inquiry problem-solving intervention to an entirely new scenario/activity in every session with the only constant being the problem to solve.

Students generated driving questions or were provided with the question at the start of each activity. The inquiry task analysis step of *Observation* indicated that students made more frequent independent observations during the activity. If a student repeated his or her experiment and planning to obtain the desired outcome, then he or she had more opportunities to make observations, increasing the opportunity to make independent observations. Likewise, when students were successful in their initial inquiry *Plan*, they would implement that plan with their *Experiment,* complete the inquiry task analysis and would have demonstrated one instance of an independent *Planning* and have less opportunity for generate more observations. Students who were successful at creating effective inquiry plans and executing them with proficiency had fewer frequencies in independent planning. For example, Steve had a high level of independent planning and experimenting, because he would come up with an initial idea that was not successful, but was independent in observing that the initial plan didn't work, re-planned and re-ran experiments, increasing his frequencies. Similar to Steve, Kourtney required revision of plans and experiments and prompting from facilitators to generate the new plan, resulting in increased opportunities for new experiments and observations and fewer independent plans.

To reduce the load on the working memory, the self-monitoring checklist was designed to cue initial inquiry schema as well as the steps in the inquiry task analysis when students needed assistance. As students developed the problem-solving schema and navigated through inquiry steps, they relied less on the checklist and used it as a self-reflective/self-reporting tool to evaluate their task completion or to prompt themselves to complete the next step. Other times, students would complete the entire activity then refer to the checklist and verbalize the steps they completed. Futures studies should investigate the benefits of checklists in self-reflection of sequence process skills and activities.

Limitations

This study was not without limitations. Although student independence increased across conditions, baseline data for both Becca and Kourtney were variable. Eighty percent of their baseline scores did not fall within 20% of the mean. However, the baseline probes did not show positive or negative trends indicating a pattern in the data. Predictions of continued baseline data could be made but with less accuracy than a stable baseline.

A second limitation is the lack of generalizability of the study's findings. Results indicated high internal validity for experimental control. To be established as an evidence-based practice and the generalizability of this single-case study, replication is required across five studies by other researchers and with twenty or more participants (Horner et al., 2005). Three students participated in this study demonstrating increases in autonomy in problem solving in both science standards related activities and functional problem-solving activities. The students in this study also represented a homogenous population of secondary students in a very successful secondary school in a small Midwest town. Future replications should consider including more diverse locations and populations such as elementary age students, young pre-school children, or adults in post-school settings who are economically, ethnically, and culturally diverse.

A third limitation is engaging students in applied research. When conducting research in classrooms, many variables often occur that affect student's behavior and performance (Alberto & Troutman, 2006). Examples of variables encountered during this study included medication changes, schedule changes, reported hormone changes, and illness. For example, special activities would be conducted often in the afternoon during session causing Steve anxiety about missing them. Becca engaged in an emotional response that included crying and yelling at paraprofessionals prior to sessions following overeating and having her food removed.

Conclusions and Recommendations

The present study extended findings from Miller and Taber-Doughty (in press), Jimenez, Browder, and Courtade (2010), and Jimenez, Browder, Spooner, & DiBiase (2012), investigating the impact of science inquiry investigation and self-monitoring interventions for students with moderate intellectual disability. Unlike the previous studies (e.g., Jimenez et al.) this investigation incorporated generalization phases making the connections to functional application of science inquiry problem-solving skills, and expanding on generalization. The findings indicate that students with a moderate intellectual disability can use self-monitoring checklist to acquire, apply, and generalize inquiry problem-solving skills. Replication studies are needed to verify these findings and confirm the role of the checklist compared with guided inquiry methods or using guided inquiry methods without a self-monitoring checklist. It is plausible that students learned the inquiry problem-solving skills over time via the use of guided-inquiry teaching methods and used the checklist as a way to check their work after the fact.

Future studies should examine the role that guided inquiry methods play in building self-determination skills. Empirical evidence is lacking from the literature that demonstrate interventions increasing self-determination and meaningful outcomes stemming from self-determination interventions (Algozzine, Browder, Karvonen, Test, & Wood, 2001). Futures studies should also continue to look at the use of self-monitoring interventions such as a self-monitoring checklist paired with guided inquiry for inclusion in grade-level science activities and projects. The integration of science inquiry methods can bring added benefits for this population who are involved in inclusive settings. This study was conducted in small Midwest high school; therefore, to strengthen these findings and generalizability, studies involving larger numbers and more diverse participants should be conducted (Horner et al., 2005). Researchers should also consider studies observing the teachers as facilitators, both special and general education (Courtade et al., 2012).

Research suggests that inquiry methods help students acquire critical thinking skills, self-determination, and the ability to problem-solve (NGA, 2010; NRC, 1996). Science inquiry methods are linked to self-determination models for students with more moderate and severe intellectual disability (Agran et al., 2006; Spooner et al., 2011). Self-monitoring devices that scaffold inquiry problem-solving steps may hold potential for students with a moderate intellectual disability (Jimenez et al., 2010; Miller & Taber-Doughty in press). Therefore, future research should examine the benefits that self-monitoring inquiry methods hold for students post high school, the interventions to support these skills across settings, and support for increased levels of independence when performing these skills.

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Received: 18 March 2014
Initial Acceptance: 20 May 2014
Final Acceptance: 22 August 2014