Self-Monitoring Checklists for Inquiry Problem-Solving:
Functional Problem-Solving Methods for Students with
Intellectual Disability

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Abstract: Three students with mild to moderate intellectual and multiple disability, enrolled in a self-contained functional curriculum class were taught to use a self-monitoring checklist and science notebook to increase independence in inquiry problem-solving skills. Using a single-subject multiple-probe design, all students acquired inquiry problem-solving skills during exposure to functional guided science inquiry lessons and demonstrated the problem-solving skills independently. Students successfully generalized inquiry problem-solving skills to two functional problem scenarios during a generalization phase.

Students enrolled in a functional curriculum focus on life skills for greater post high school autonomy (Snell & Brown, 2011). While this curricular approach centers on skills associated with community, domestic, vocational, and recreational/leisure domains often taught in community-based or self-contained settings, IDEA (2004) mandates all students have access to the general curriculum and are provided instruction in least restrictive environments (LRE), including inclusive classroom settings. Providing instruction in their LRE, ranging from self-contained classrooms to inclusive settings, raises expectations for all students with disabilities and can increase educational performance resulting in improved outcomes (Karger, 2005).

Congress passed the No Child Left Behind Act (NCLB) in 2001 to create an equal opportunity for all children to receive a high-quality education and attain proficiency on state achievement standards and assessments (20 U.S.C. § 6301). Overall, this law focused on ensuring that all students with a disability have access to a high quality education, continued educational opportunities, high academic expectations, and exposure to the academics of their peers without disabilities (Hitchcock, Meyer, Rose, & Jackson, 2002). While a general curricular focus may prepare many students with and without disabilities for participation in statewide assessments, some may lack the cognitive skills to participate successfully or gain the skills necessary for post-school functioning (Ayers, Lowery, Douglas, & Sievers, 2011). Thus, NCLB allowed for an alternative curriculum and assessment to meet their individual learning needs. However, to meet the law’s accountability measure, lawmakers required that alternative assessments and curriculum be linked to grade-level standards (Ayers et al., 2011; Yell, Drasgrow, & Lowery, 2005). For students who access a functional curriculum, few models for teaching and modifying general academic content in an alternative manner exist in the literature (Browder et al., 2012; Courtade, Spooner, & Browder 2007; Spooner, Knight, Browder, Jimenez, & Warren, 2011).

Ayers and his colleagues (2011) questioned if students with a moderate to severe intellectual disability should be learning general education content when the instructional priority should be spent on functional skills. Currently, researchers are investigating how academic content (e.g., mathematics, science, literacy) can be provided to students with
moderate intellectual disability (Browder et al., 2012). For example, Jimenez and colleagues (2012) reported success in teaching students with a moderate intellectual disability to use inquiry science skills. Students acquired skills related to changing weather patterns, life cycles, and earth formations using peer mediated time delay and guided inquiry method knowledge charts. The instructional content for students within a functional curriculum generally focuses on the topics of weather, health, money and measurement (Browder et al., 2012; Spooner, Ahlgrim-Delzell, Kohprasert, Baker, & Courtade, 2008), topics that seem to hold the most functional value for this population. Yet these studies fail to connect content to functional daily living situations and help students generalize skills to functional applications. Collins, Hager, and Galloway (2011) found success using time delay procedures to teach students with a moderate intellectual disability combined grade level and functional content related to cooking, dressing for the weather (science), sight words, information in the news (language arts), and the skills to apply sales tax to items in local advertisements, as well as the order of operations, making the integration of science content meaningful for students in a functional curriculum by applying it to meaningful daily skills. Thus, investigators noted that the field should continue to identify evidence-based practices that provide access to grade-level academic content mandated by law, while providing functional and meaningful outcomes for students with a mild to moderate intellectual disability (Courtade et al., 2007; Collins, Karl, Riggs, Galloway & Hagar, 2010; Miller, 2012). Unfortunately, one academic content area in which little research exists is in the area of science for individuals who experience a moderate intellectual disability (Browder et al., 2012). Without meaningful science instruction and research in this area, investigators may be unable to identify relevant instructional strategies and foci for preparing students with an intellectual disability to gain relevant life skills in the areas of problem-solving and actively interacting with the world around them (Miller, Krockover, & Doughty, in press).

Science through Inquiry

Science standards integrate both self-determination and problem-solving skills though inquiry methods and can provide both functional and content instruction for students with an intellectual disability. The functional curriculum that includes skills of daily problem-solving, adaptability and general independence in the area of life skills (Brown et al., 1979; Parrish & Stodden, 2009), aligns with the objectives of the National Science Education Standards (NSES) and includes problem-solving, adaptability, and understanding the natural world. The Next Generation Science Standards (NGSS) (National Academy of Science, 2011) focus on limited core concepts and ideas and are designed around scientific inquiry (National Science Teacher Association, 2011). Spooner et al., (2011) propose that inquiry should be a major focus of science instruction for students with an intellectual disability and should focus on problem-solving skill sets compared to memorization of science vocabulary that holds less functional value.

The NRC (2000) defined inquiry as “a set of interrelated processes by which scientists and students pose questions about the natural world and investigate phenomena; in doing so, students acquire knowledge and develop a rich understanding of concepts, principles, models, and theories” (p. 214). Students in a functional curriculum can use inquiry to problem-solve, adapt in daily living situations, and make decisions. Jimenez, Browder, & Courtade, (2010) found that students with a moderate intellectual disability acquired self-directed learning of inquiry skills during science instruction almost immediately. Students were able to use self-directed learning prompts to acquire and gain independence in inquiry science lessons in both chemistry and physical science and generalize it to the general science classroom following individualized instruction.

Inquiry

Inquiry methods of instruction are designed to address processing and thinking skills in natural contexts where both the concepts and skills are acquired and strengthened by the
One common inquiry model known as the 5E’s (Engagement, Exploration, Explanation, Elaboration, and Evaluation) is successful in K-12 science instruction and is accepted as best practice in science education (Bybee et al., 2006, NRC 1996). Jimenez et al., (2010) modified the 5E’s into what we know (K), want to know (W), how we found out (H), and what we learned (L), making a KWHL chart where students were able to successfully self-monitor their progress through guided inquiry lessons.

Inquiry is a dynamic process where students continually shape and reshape their thoughts based on new knowledge and experiences (Hammerman, 2006). Full inquiry is student-driven, where the teacher acts as a facilitator and provides guidance. Guided inquiry methods are still student-driven with teacher as facilitator, but allows for a more structured outline to be provided. For students with an intellectual disability, guided inquiry methods can be used (NRC 1996) where a facilitator or visual cue guides students to the posed question for investigation, or the facilitator provides it versus a student-generated question; the facilitator or visual cue guides student to observations to be made or data to collect; the learner is guided to, or provided possible connections; and the learner can be provided with broad guidelines to sharpen and communicate, or is guided and prompted to make logical explanations. In addition to guidance from the facilitator, interventions to assist students in self-monitoring their progress through instruction can be integrated with guided science inquiry to promote increased independence for students with an intellectual disability.

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Self-Monitoring and Inquiry Task Analysis

Increased independence and the ability to self-monitor behaviors is a key objective for students with an intellectual disability (Snell & Brown, 2011). Self-monitoring is a skill within the self-management paradigm containing several strategies designed to facilitate an individual’s ability to manage his or her own behavior (Shapiro, 1981). The ability to self-monitor can increase students’ independence when performing given tasks and promotes greater autonomy and increased quality of life (Agran, Cavin, Wehmeyer, & Palmer, 2006).

When acquiring self-monitoring skills, students may require additional supports (Jimenez et al., 2012). Common supports used for self-monitoring include checklists (Cooper & Browder, 2000), self-operated audio prompts (Tabert, Albert, & Fredrick, 1998), and video-models. When implemented in community (Mechling, Gast, & Langone, 2002), leisure (Taber-Doughty, Patton, & Brennan, 2008), domestic (Bidwell & Rehfeldt, 2004), and vocational settings (Allen, Bowen, Burke, Renes, & Wallace, 2010) self prompting systems led to greater independent functioning, task transition, and performance accuracy for students with a moderate to severe intellectual disability.

Inquiry as a Tool to Self-Monitor Problem-Solving

For students with an intellectual disability, scientific inquiry can serve as a self-monitoring strategy for problem-solving. Students can follow the five steps of inquiry as they self-monitor their progress through solving a problem. Asking, Did I question? Plan? Observe? Investigate? and Explain?, each can use inquiry steps to self-monitor how they problem-solve. The use of video modeling, adapted science notebooks, checklists, and picture prompts can be used to support the self-monitoring of inquiry skills. For example, Miller, Krockover and Doughty (in press) used self-operated picture prompts to represent inquiry task steps and placed them in student’s science notebooks when completing science activities. They found that students with a moderate intellectual disability successfully acquired science content through the use of both traditional science and electronic notebooks in conjunction with guided science inquiry instruction. Students not only learned to self-monitor their own behavior, they did so while acquiring and following the steps of scientific inquiry during life science and chemistry instruction. As such, students demonstrated a potential for acquiring and applying a set of complex problem-solving skills in an academic area typically not considered part of a functional curriculum.

With increasing numbers of students with disabilities participating in inclusive classroom settings, more research is needed to confirm...
the success of effective practices. Thus, continued research is needed to investigate the benefits of both guided inquiry and the use of self-monitoring supports for completing science inquiry instruction for both functional science content and generalization of inquiry skills to daily living problem-solving application. The current study examined the effectiveness of self-operated checklists and self-recording using a science notebook during guided science inquiry instruction. Specifically, students with a mild or moderate intellectual disability self-monitored their own behavior during guided science inquiry activities using a checklist and science notebook. Data were also gathered on students’ ability to generalize problem-solving skills to daily problem situations.

Method

Participants and Settings

Three students were recruited from a local rural Midwest middle school through their classroom teacher. To participate in the study, students were a) identified as having a mild or moderate intellectual disability as determined by a valid measure such as the Weschler Intelligence/Stanford-Binet test and a moderate to severe adaptive behavior score on the Vineland or comparable assessment, b) of middle school age, and c) enrolled in a functional curriculum. In addition, parental/guardian consent was provided for all students to participate in addition to student assent. For each participating student, no science content instruction was part of his or her current curriculum and each received no prior science instruction. See Table 1 for information on each student.

Phoebe. Phoebe was identified as having a multiple disability that included language, speech, and an intellectual disability, ADHD, a cleft palate, and other health disabilities. Her full-scale IQ score was 63 (Weschler) and her adaptive behavior on the Vineland-II was 56. She was placed in a self-contained classroom and received instruction in a functional curriculum. According to her classroom teacher, she was eager to participate in any activity and actively engaged in discussions and activities. Her teacher reported that Phoebe struggled with social skills, demonstrating short temperaments and lack of patience with her peers by raising her voice, rolling her eyes, sighing, throwing her arms down, and walking away from them while they were speaking. Phoebe also demonstrated difficulty maintaining attention when working on a task, often drifting off topic, or engaging in a verbal confrontation with a peer due to a disagreement or dislike of their contribution to the given task.

Claire. Claire was identified with multiple disabilities that included a language, seizure, and intellectual disability as well as other health impairments. Her IQ score was 64 (Kaufman) and her adaptive behavior on the Adaptive Behavior Assessment System Second Edition (ABAS-2) was 47. She was served in a self-contained classroom and received instruction in a functional curriculum. According to the classroom teacher, Claire required repetition and prompting over long periods of time for acquisition and maintenance of new concepts. In addition, she required frequent verbal prompts to complete unfamiliar activities. Claire was able to decode text but struggled to

<table>
<thead>
<tr>
<th>Student</th>
<th>Chronological Age</th>
<th>Ethnicity</th>
<th>Adaptive Behavior</th>
<th>IQ</th>
<th>Primary Disability</th>
<th>Secondary Disabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claire</td>
<td>12</td>
<td>Caucasian</td>
<td>47c</td>
<td>64b</td>
<td>Intellectual Disability</td>
<td>Lang/Seizure,</td>
</tr>
<tr>
<td>Phoebe</td>
<td>13</td>
<td>Caucasian</td>
<td>56d</td>
<td>63a</td>
<td>Intellectual Disability</td>
<td>Speech/language, ADHD, Cleft palate</td>
</tr>
<tr>
<td>Chester</td>
<td>12</td>
<td>Latino</td>
<td>55c</td>
<td>46a</td>
<td>Intellectual Disability</td>
<td>IADHD, Lang</td>
</tr>
</tbody>
</table>

*a WISC-IV, b Kaufman, c ABAS-2, d Vineland-II*
comprehend longer narratives. She was able to read and comprehend single functional words and text read aloud to her. She was also able to write short sentences, spelling phonetically. According to the Claire’s teacher, she struggled in mathematics, but demonstrated the ability to do simple addition and subtraction using illustrations and manipulatives. Claire was also able to measure when cooking using standard units.

Chester. Chester was identified with a multiple disability that included other health impairments, moderate intellectual disability, ADHD, and language disability. His full-scale IQ score was 46 (Wechsler) with an adaptive behavior score on the ABAS-2 of 55. He was served in a self-contained classroom where he received instruction in a functional curriculum. According to his teacher, he was an enthusiastic student who was always willing to assist his peers. His teacher described him as confident and not afraid to try new tasks. Chester demonstrated strong decoding and comprehension skills and was able to recall information he read and heard. He was also able to write short sentences. Chester’s classroom teacher noted he struggled with mathematics, but was able to add and subtract using manipulatives and measure using standard and non-standard units.

Setting

Instruction took place in a room adjacent to the main classroom. The room was a kitchenette consisting of cabinets with basic kitchen utensils, a sink, refrigerator and microwave. The room contained two round tables with five chairs at each with access to a large corridor next to a wall of windows for viewing the outdoors as well as direct access to an outside field. This space was considered ideal for science lessons as it was away from other students and provided direct access to class materials.

Independent and Dependent Variables

The independent variable was a self-monitoring checklist and the use of a science notebook that guided students through the five inquiry problem-solving steps of generating a question, making observations, creating a plan to answer the question, conducting an experiment, and explaining their findings. The dependent variable was the percent of task analysis steps each student completed independently during inquiry problem-solving activities. Inquiry problem-solving activities were divided into task analysis steps and measured during baseline and intervention conditions.

Materials

Checklists. The checklist consisted of an 8” × 11” laminated paper containing five picture symbols and representing the five steps of inquiry (Question, Observe, Plan, Experiment, and Explain). Beside each image were two columns labeled “Completed” and “To Do” with boxes below each column. In each box, students could write a check mark as they completed a given task. The 8” × 11” checklist was laminated or both durability and for the use of dry erase markers (Vis-à-vis). This enabled checklist to be placed inside the front of the student’s science notebook and be reused in each lesson (See Figure 1).

Science Notebooks. These consisted of a composite notebook with student’s names on the front. Using images or text, students used the notebook to record their findings and observations during each inquiry phase to assist them in planning their investigation. Each guided inquiry science lesson consisted of a variety of materials the students manipulated during investigations.

Science Lessons. The inquiry science lessons represented all areas of the sciences from earth space, science and technology, life science, and physical science and were aligned with the National Science Standards (NRC, 1996). For example, students were instructed on ultra violet (UV) rays using plastic UV beads, tanning oil and varied levels of sunscreens. Other lessons used inquiry methods to introduce the topic of measuring wind speed and direction, as students engineered anemometers with cups, pencils, pushpins and straws, to investigate changing weather patterns and how to dress, while another taught forces and motion as they explored density of liquids, and making observations as they made density bottles and learned about the importance and consequences of mixing materials such as medicines.
Inquiry Checklist

<table>
<thead>
<tr>
<th>Completed</th>
<th>To Do</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Question Icon] (Thinking)</td>
<td>![Box]</td>
</tr>
<tr>
<td>![Observe Icon] (Observing)</td>
<td>![Box]</td>
</tr>
<tr>
<td>![Plan Icon] (Planning)</td>
<td>![Box]</td>
</tr>
<tr>
<td>![Experiment Icon] (Experimenting)</td>
<td>![Box]</td>
</tr>
<tr>
<td>![Explain Icon] (Examining)</td>
<td>![Box]</td>
</tr>
</tbody>
</table>

Figure 1. Self-Monitoring Checklist: Science inquiry problem-solving task analysis
**Experimental Design**

A single subject multiple probe design was used to demonstrate the functional relationship between the self-monitoring checklist for problem-solving during guided inquiry instruction and level of independent performance (Horner et al., 2005; Kennedy, 2005). This design was selected as it exposed students to fewer sessions in baseline and reduced the likelihood of a carryover effect due to prolonged exposure to guided science inquiry instruction (Gast, 2010). This design also allowed investigators to use probe sessions during baseline, compared to continuous baseline measures (Kennedy 2005) thus likely preventing student burnout and possible reinforcement of baseline behaviors over the prolonged periods of time used in other multiple baseline designs (Gast, 2010).

**Data Collection**

Event recording was used to document the number of task steps students completed independently for each task. Event recording procedures were selected as they provided a representation of student’s actions under all conditions (Kennedy, 2005). By considering the percent of independence across lessons and generalization phases, intervention effectiveness and validity of guided science inquiry methods as it pertains to student’s typical routines was more clearly demonstrated.

**Procedure**

**Baseline.** During this condition, students were exposed to three different science lessons on the topic of what colors attract heat (reflection), mixing liquids (density), and ramps (forces and motion). The facilitator provided students with a notebook, pencil, and markers before the lessons began and explained to students how to use the science notebooks and their connection to a scientist’s field notebooks. Students were directed to draw or write about the activities they completed during their sessions. They were asked to draw five different pictures: 1) What they wanted to learn about the topic, 2) what they observed, 3) what they could do to find out about it, 3) what experiment they did, and 4) what they found out. Lessons were structured following a guided inquiry approach where the students guided the investigation and a system of least prompts was available to provide support as necessary. The facilitator noted the student’s level of independence for initiating the five task analysis steps of inquiry problem-solving: a) generating a question, b) making observations, c) creating a plan to answer the question, d) conducting an experiment, and e) explaining their findings. If the student initiated the step, the facilitator recorded a (+) on the task analysis. If the student required any prompt, the facilitator recorded a (−) on that step.

**Pre-Intervention Training.** Following baseline, students participated in two, 30-minute training sessions to use the inquiry checklists and to learn the five steps of the tasks analysis represented by the icons on the checklist (see Figure 2). During training, the facilitator first modeled the use of the checklist and demonstrated for students how to use the science notebook. For example, the facilitator showed Chloe the picture of her density bottle and checked off the first box that illustrated the icon for **Asking a Question**, “Chloe, last time the first thing you did was looked at my bottle and asked, ‘How can I make that?’ You asked a question. This was the first thing you did in our last session which is the first step on the checklist, what was your next step?” The facilitator then continued through the task analysis showing students the parallel of their activities to the checklists. To assess student’s use of the checklists, students were provided a brief formative assessment during the second training session. Each was provided a variety of five balls and asked which would be good for small kids to use to play in the water. “Find the balls that won’t sink.” The facilitator then prompted, “Use your checklist and your notebook to find out for me, OK.” Phoebe and Chloe required one verbal prompt to “Look at your checklist, what should you do next?” For the step, “How can you find out?” Chester used the checklist independently with his notebook.

**Intervention.** During this condition, procedures remained consistent with baseline with the integration of the self-monitoring checklist for five-science guided inquiry lessons. Students were provided with self-monitoring...
checklists and a dry erase marker. The topic of the session was introduced to the student to generate discussion of the topic. For example, Did you hear the tornado sirens last night? Today we are going to talk about what to investigate to do during a tornado to keep safe. Students then used their checklists to follow inquiry steps throughout the lesson. If students were prompted to use their checklist, it was counted as a prompt. Due to the nature of guided inquiry where the teacher guided students to further develop previous ideas, each was required to independently initiate the inquiry step to count as completing that step independently. For example, if the student planned and began conducting the experi-
ment yet required facilitator assistance, it was considered independent. Student performance was also independent if the student initiated an original plan and later modified it following questions and discussions with the teacher.

**Generalization.** Following intervention, students participated in a generalization phase consisting of two sessions. Each session followed the same procedures as intervention but inquiry problems included functional situations. Two generalization phases mirrored intervention where students were provided self-monitoring checklists and provided a functional problem to solve. For example, students were presented with a broken shoelace and asked, “Do you have any idea how you could help me fix this? Use your Checklist and notebook like we usually do.” Students were then provided with a variety of materials such as glue, scissors, scotch tape, masking tape, markers, and string. Data were recorded on the number of task steps students completed independently.

**Social Validity**

Social validity interviews were conducted to examine the social appeal, applied value, and practicality of the intervention used in the study. A revised Treatment Acceptability Rating Form (TARF-R) (Reimers & Wacker, 1988) consisting of 13 Likert style questions was used to conduct an interview with students at the conclusion of the study. The facilitator read the questions and possible responses aloud to students, explaining the scale. Students then recorded their response using paper and pencil.

**Interobserver Agreement and Treatment Fidelity**

Interobserver agreement (IOA) was collected by a second trained independent observer for 33% of baseline sessions, 40% of intervention sessions, and 50% of generalization sessions to ensure the reliability of data for each student. IOA was calculated as the number of agreements divided by the number of agreements plus disagreements, multiplied by 100. IOA for all sessions for each student resulted in 100%. A measure of treatment fidelity was also conducted to ensure that each intervention procedure was accurately and consistently implemented. To ensure treatment fidelity, a checklist containing the task analysis of the intervention procedures was created and a volunteer was trained in its use to monitor the facilitator during intervention sessions. Treatment fidelity was conducted for 40% of the intervention sessions resulting in 95% treatment fidelity, and 50% of the generalization phases resulting in 100% for all students.

**Results**

Results indicated all students acquired the steps in the inquiry problem-solving routine and were able to perform steps independently using the self-monitoring checklist during guided science inquiry instruction. Each was also able to generalize the use of the checklist to functional problem-solving scenarios during a generalization phase. Figure 2 illustrates student performance using in inquiry checklists and science notebooks during baseline, intervention, and generalization conditions.

*Claire.* During baseline, Claire independently completed an average 6.67% of inquiry task analysis steps when completing science investigations. During intervention, the level immediately increased to an average 96% with the use of the self-monitoring checklist during science instruction. This level remained high during the generalization phase with an average 96% of inquiry task analysis steps completed independently when using self-monitoring checklists to complete functional problem-solving lessons. Visual analysis indicated no overlapping data between baseline and intervention phases. Baseline indicates a slight variation in data ranging from 0%–20%. Intervention data ranging between 80%–100% indicated minimal variation. During the generalization phase, visual analysis indicated that the trend remained stable and high at 90% with little variation in the data range between 80%–100%.

*Phoebe.* Phoebe’s independence when completing inquiry task analysis steps during science instruction averaged 6.67% during baseline. During intervention this mean immediately increased to high levels with a mean of 100% when using self-monitoring checklists during science instruction. This high level was maintained during the generalization phase.
with a mean of 100% when using the self-monitoring checklists during functional problem-solving instruction. Visual analysis indicated no overlap in data between baseline and intervention phases. Data within phases indicate little to no variation with a range in baseline data between 0%–20%, and no variation in intervention or generalization. Overall, data demonstrated an immediate and stable upward trend across baseline into intervention and generalization phases.

Chester. When investigating science concepts during baseline, Chester’s average when independently completing inquiry task analysis steps was 6.67% (Range: 0%–20%). During intervention, this showed an immediate increase to 100% with the use of the self-monitoring checklist. This increase in performance continued during the generalization phase with an average of 100% independence of inquiry task analysis steps with the use of the self-monitoring checklist for functional problem-solving activities. Visual analysis indicated no overlap in data between baseline and intervention phases. During baseline his data demonstrated a slight variation ranging from 0%–20%. During both the intervention and generalization phases, visual analysis indicated no variation. The overall data demonstrated an immediate positive stable trend from baseline to intervention and into generalization.

Social Validity

Social validity measures were conducted using the Treatment Acceptability Rating Form (TARF-R) (Reimers & Wacker, 1988) with each student. Students listened to each question and recorded their responses. All three students indicated they enjoyed doing science lessons and wanted to continue doing science investigations. Two students expressed that using the science notebooks were useful during their lessons, while one expressed, “I just like doing things.” All three verbally indicated the checklists helped them recall the steps for doing science investigations and wanted to continue using them in the future. Students expressed that they would recommend science lessons and checklists to their friends and use them for other areas of instruction.

Discussion

All students in this study increased their independence in guided inquiry procedures with the use of self-monitoring checklists and science notebooks and all were able to generalize the inquiry skills from science content instruction to functional problem-solving situations during the generalization phase. These findings support those by Jimenez et al. (2010) suggesting inquiry problem-solving methods for students with intellectual disability can be acquired in a short period of time. Inquiry methods hold great potential for students with an intellectual disability, as they were able to generalize steps to solve daily problems in the generalization phase supporting Spooner et al.’s, (2011) suggestion that inquiry processes are an appropriate science content connection for students in a functional curriculum.

This study confirmed previous findings indicating the effectiveness of science inquiry methods when used by students with a mild to moderate intellectual disability. Claire, Phoebe, and Chester were all able to independently engage in science inquiry activities (Jimenez et al., 2010, 2012). Additionally, the effectiveness of checklists as a means of self-monitoring was also confirmed (Cooper & Browder, 2000). Each student was able to quickly acquire the skills to independently monitor his or her own inquiry behavior using the checklist. Finally, the ability to teach students with an intellectual disability who were engaged in a functional curriculum how to use inquiry (Jimenez et al., 2012; Miller, Krockover, & Doughty, in press) was confirmed as all three demonstrated immediate changes in level of performance in both core academic context and functional daily situations. Independent inquiry was not only applicable in the context of scientific investigation but students generalized it to a self-monitoring tool for functional problem-solving situations.

A need exists to identify interventions for integrating content instruction in meaningful contexts for individuals with an intellectual disability that result in functional outcomes. The present investigation expanded Jimenez et al. (2010) results examining the effectiveness of inquiry methods as a functional skill.
for secondary students with an intellectual disability. To ensure inquiry skills generalized to real-world problem-solving in the present study, students completed applied activities that required them to use their science inquiry skills in a functional way. The resulting evidence supports the use of guided science inquiry when teaching students with an intellectual disability to problem-solve and lends itself to functional problem-solving. All three students successfully used the self-monitoring inquiry checklist and generalized it to functional problem-solving situations. During intervention sessions, students remained on task and engaged with materials. Claire and Chester immediately asked questions and touched materials upon entering the room. However, Phoebe was more reserved and would wait for the teacher to initiate an activity before handling materials. Once a session began, she would become very talkative and easily manipulated the available materials. When designing an original birdfeeder, Phoebe originally closed off access to the birdseed inside. The teacher commented and asked, “I like your design. Can you tell me about it?” When Phoebe talked about her feeder she noticed the design flaw and revised her feeder, initiating the design, observations and explanations independently. The use of physical materials during investigations engaged students in activities and they expressed that they liked having choices in what materials they could use and activities they could do. Futures studies should continue to focus on functional investigations that involve the use of physical materials. In addition, with the advent of technology and various digital tools, investigators might examine how independently students are able to solve science problems that are functional in nature when using virtual manipulatives.

While students always remained on task during science activities, Claire required frequent prompts to record (write or draw) her responses into her science notebook. This may be attributed to her active engagement in the ongoing activity and unwillingness to stop to record her observations. Writing was also not an activity she favored and one in which she struggled. Concomitantly, all students verbally expressed numerous ideas during their science activity, when asked to record their findings in their notebooks, they would write or draw only a single idea. This may also be ascribed to their poor writing skills and increased level of engagement with the activities. Future studies should investigate more activity-based recording, for example students documenting their experiments through video logs during the activity. Methods such as this may be more appealing to Claire as a means to record her findings during instruction. Alternatively, for students who dislike writing and traditional science notebook procedures, alternative formats such as dictation, use of audio, digital video recording and other technologies should be investigated.

Limitations

The current study had several limitations. Use of the science notebooks during the guided inquiry science instruction was distracting and at times a barrier for Claire who disliked the writing aspect. Although she was very verbally expressive during instruction, she appeared to not like recording ideas in the science notebook. She continually avoided the use of the science notebook by pushing it off to the side and when prompted to use the notebook, she quickly jotted down a word or two or drew a quick picture before returning to her activity. During the social validity interview she indicated that using the science notebook was OK but that she wouldn’t want to continue using it in the future. Future studies should consider alternative means of science note booking such as dictation software or video camera entries which could be recorded on iPads or iPods, as well as other problem-solving and critical thinking interventions that may not require the use of recording information. Another limitation was that students only completed two functional problems using inquiry skills during generalization. Future studies should explore the application of inquiry problem-solving methods in-vivo across settings for a variety of daily living scenarios. For example, having students apply inquiry problem-solving methods across community settings or in a social context when working with social scenarios. Another area for further investigation is the use of self-monitoring checklists and the versatility of checklists across functional tasks, and the use of dynamic
checklists that are available on mobile devices such as cell phones and other electronics through applications that may hold function for students with a moderate intellectual disability.

References


cepts, and core ideas. Science Education at the National Research Council.

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