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Perceptions of Service Providers Regarding the Agency and Capacity of People with Intellectual Disability to Vote

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Abstract: Although the right to vote is guaranteed for all U.S. citizens of voting age, a significant number of adults with intellectual disability do not vote. The purpose of the present study was to replicate a previous study conducted by Agran, MacLean, and Kitchen-Andren (2015), which examined the extent to which adults with intellectual disability in a sample were registered to vote and if they had received voting-related instruction. Input from direct service provider, case managers, and other stakeholders was obtained, and both statistical and qualitative analyses of respondents’ comments were conducted. Last, responses before and after the most recent election were compared to determine if there were changes in attitudes that might be the result of the election. The findings revealed that most clients were not registered to vote, had expressed little interest in voting, and had not received voting-related instruction. The implications of these findings are discussed.

The 14th Amendment of the U.S. Constitution specifies:

No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any State deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws.

Although voting is guaranteed for all U.S. citizens, there have been nevertheless numerous instances where certain groups’ ability to vote has been restricted (Schriner & Ochs, 2000). Although voting is a constitutional right, decisions about voting eligibility, regulations, and policies about accommodations are typically determined at the state level. For instance, felons in many states are denied the ability to vote because of their criminal act; that is, they are denied citizenship due to their misdeeds (Sabatino & Hurme, 2009). People with intellectual disability may also face difficulty regarding voting. Although they have not committed felonious crimes, individuals with intellectual disability may be prevented from voting because it is believed that they are incapable of voting; that is, they are considered to be non composita mentis (i.e., not of sound mind). As such, individuals with intellectual disability retain the constitutional right to vote but may have this right denied because voting officials believe they do not have the competence or capacity to do so (Schriner & Ochs, 2000).

Although there is limited research on the number of adults with intellectual disability who vote, the available research suggests that this number is relatively low when compared to the typical population—especially for individuals with more severe or significant disabilities. For example, Agran and Hughes (2013) surveyed a sample of direct service providers and support personnel to obtain input on whether they believed that people with intellectual disability should vote, did they provide voting instruction to consumers, and if their consumers expressed an interest in voting. The majority of respondents indicated that...
they rarely provided or were asked to provide voting instruction, and that few consumers with intellectual disability voted, were registered to vote, or had expressed an interest in voting. Additionally, parents or guardians of these consumers rarely indicated an interest in having their children learn to vote, and many believed there were other and more important skills to teach. Although there was mixed opinion regarding the value of voting for individuals with intellectual disability, the majority of respondents said they would provide such instruction if they were asked to do so by consumers.

Agran et al. (2015) surveyed a sample of service providers (e.g., support personnel, Medicaid waiver case managers) to obtain their input on consumers’ voting participation. Sixty-six (66) completed responses were submitted. The respondents were asked to share their opinions about consumers’ knowledge about voting, whether they had an interest in voting, whether their consumers were registered to vote, what was their consumers’ familiarity with polling places, and the degree to which voting was included in their service plans or was a focus of instruction. The majority of respondents indicated that voting is a fundamental right for all citizens, including people with intellectual disability. Further, the majority indicated that people with intellectual disability knew what voting is, had expressed an interest in voting, and were registered to vote, what was their consumers’ familiarity with polling places, and the degree to which voting was included in their service plans or was a focus of instruction. The majority of respondents indicated that voting is a fundamental right for all citizens, including people with intellectual disability. Further, the majority indicated that people with intellectual disability knew what voting is, had expressed an interest in voting, and were registered to vote. However, few of the respondents indicated that they provided voting instruction to their consumers or had voting included in their service plans. They provided several reasons for this failure. These included: lack of consumers’ interest, uncertainty that consumers would benefit from instruction, and lack of time and/or instructional materials to teach targeted skills.

In all, it has been estimated that fewer than half of individuals with disabilities vote, and for individuals with with more significant disabilities, the number is considerably lower (National Council on Disability, 2011). At the very least there is a 20% difference in the number of voters between individuals with intellectual disability and voters in the general population (Shields et al., 1998; Ward et al., 2009); in all, a significant number.

Our democracy is based on the assumption that all citizens will be involved in and committed to democratic governance and thus will be capable of making an informed vote based on their knowledge and understanding of key political issues, i.e., their legal capacity (Lanning, 2008). As Lanning indicated, a democracy is characterized by citizenry in which citizens act as equals (have equal rights), however, when a group of citizens either abstains from voting or is denied the right to vote, government necessarily becomes less democratic. Although it may be allowable to deny an individual the right to vote if that person doesn’t seem to know what he or she is doing or has no understanding of political issues (Bell et al., 2001), a reliable and consistent way to determine voter competency has yet to be developed. Consequently, eligibility decisions may be arbitrary, open to subjective opinions, highly variable (differ from state to state if not county to county), and may be status- (restriction based on a category of people) rather than capacity-based (individual competence; Beckman, 2014). Although to our knowledge there is not a state-by-state report on the number of individuals with intellectual disability who have been denied the opportunity to vote, several reasons have been suggested to explain what would appear to be a low level of voter participation. These include: failure to provide consumers with systematic voting instruction (Pavey, 2003); lack of staff preparedness in supporting consumers to vote (King & Ebrahim, 2007); consumers’ and/or their parents’ lack of interest in voting or receiving instruction to do so (Agran et al., 2016); and lack of accessible polling places or instructional materials (Bell et al., 2001), among others. Each of these, singularly or in combination, may not only prevent individuals from voting or exacerbate the problem but, regrettably, only serve to accentuate or highlight the perceived incompetence of people with intellectual disability.

Despite committed government action to safeguard the voting rights of people with intellectual disability and other developmental disabilities (e.g., Voting Rights Act of 1965, the Voting Accessibility for the Elderly and Handicapped Act of 1984, the Americans with Disabilities Act of 1990), it would appear that a limited number of individuals with intellec-
tual and developmental disabilities actively participate in voting. The purpose of the present study was to conduct a systematic replication of Agran et al. (2015). The basis for this replication was two-fold. First, the sample size for the Agran et al. (2015) investigation was relatively small and Agran et al. recommended that future replications were needed. Second, there is limited empirical research that has investigated voting participation for people with intellectual disability. As Nosek et al., (2016) noted, scientific claims are validated by the replicability of the supporting evidence. We believed that an extended database could contribute to our understanding of voter participation. Specifically, our intent was to have additional data on the frequency of participation in voting of people with intellectual disability, identify the reasons why relatively few individuals with intellectual disability vote, and, based on the respondents’ responses, recommend what may be done to encourage voting for this population. Although no major changes were made to the survey, the replication was conducted to obtain a larger sample size than the one reported in Agran et al. (2015) Also, only descriptive data had previously been reported but in the present study we conducted several statistical analyses and qualitatively analyzed the open-ended responses to determine if any themes would emerge regarding the respondents’ attitudes about voting. Last, since the survey was disseminated at or around the time of the 2016 presidential election, which proved to be a highly contentious election with much media exposure, we explored if there were any changes in responses that might have been as a result of this election.

Method

Participants

Participants were recruited through an existing email database of individuals who serve or work with individuals with intellectual disability in the state of Wyoming (e.g., direct support personnel, Medicaid waiver case managers). Given the close relationship they have with consumers and the support they provided, it was believed that they would have and be willing to share information about their consumers’ voting experiences, and they would have been responsible for providing voting instruction if it had been requested. An announcement was emailed to participants, explaining that the researchers were administering an online, non-partisan survey examining voting participation among individuals with intellectual disability. The announcement provided potential participants with a web link to the online survey. If participants selected the link, they were provided with an informed consent form; if they chose to voluntarily participate, they were directed to the survey questions. Participants answered seven demographic questions and 25 questions regarding the people they serve and their presumed voting participation. Upon completing the survey, participants were entered in a raffle for a chance to win a $50 Amazon gift card. The announcement was emailed to potential participants three times prior to election and three times post-election. Eighty-eight (88) participants completed the survey prior to the November 8, 2016 election and 33 completed the survey after the election.

All participants were treated in accordance with APA ethical guidelines and the research study was approved by the Institutional Review Board at the first author’s university affiliation.

Survey

As indicated previously, we employed the same survey used in the Agran et al. (2015) investigation. The survey included Likert-scale, multiple choice, and open-ended items. Basic socio-demographic information was collected, including: gender, age, education, years of experience as a stakeholder, professional role, and the nature of the support needs of consumers served. Respondents were asked to share information about the voting experiences of their consumers. Specifically, participants were asked to indicate how often their consumers expressed that they wanted to learn how to vote; how often they expressed that they wanted to vote; how often were consumers instructed on how to vote; the percentage of how many of their consumers knew what voting was; and how many of their consumers (to their knowledge) were registered to vote. Participants were also asked to indi-
cate how often voting was included in consumers, Individualized Service Plans, whether their consumers have ever been shown polling places, and how many of their consumers were legally disenfranchised (i.e., legally denied the right to vote).

Further, participants were asked to indicate their level of agreement with several statements. These included: “All things considered, people with intellectual disability cannot be expected to provide a meaningful vote,” “Teaching consumers to vote is a worthwhile objective,” and “Please indicate how much you agree that political issues or campaigning information could be presented (or explained) to consumers with intellectual disabilities.” A scale from 1 = strongly disagree to 5 = strongly agree was used to quantify their responses. Additionally, respondents were asked: “Do you believe instructional materials can be prepared (or are available) that will allow your consumers to understand different political issues or positions (e.g., taxation, public assistance),” if they have provided such voting instruction, and, if they had provided instruction, what strategies did they use. Also, barriers and strategies to voting were assessed by asking participants to indicate the most influential barriers to voting they experienced (e.g., lack of transportation to polling places, lack of instruction on how to vote [either school or agency based]).

Last, participants were asked whether their consumers ever mentioned that voting has been discussed at their homes (yes/no response), and whether they (the providers) had contacted their state’s Protection and Advocacy, System Inc. (P&A) to provide instruction about voting to their consumers (yes/no response). Also, participants were asked to list additional strategies they used when providing voting instruction, what influenced their beliefs about the importance/unimportance of teaching consumers to vote, and what might be done to increase voter turnout among individuals with intellectual disability in their state.

Data Analysis

Initial analyses focused on whether responses changed after the most recent election using a series of t-tests or chi-squares. Second, we tested for differences by respondent role using ANOVAs and chi-squares. For all these tests alpha was set at .05. Finally, we examined means and frequencies for each item to explore the sample characteristics, paying careful attention to open-ended questions to clarify responses.

Results

Eight-eight participants completed the survey (see Table 1). Most of the respondents were female, and the majority were over 50 years of age. Approximately one-third had an undergraduate degree (35%) and one-third having a graduate degree. The majority had 10 or more years of experience in disability support and services. Further, most participants reported providing service to individuals with either moderate to severe intellectual disability or individuals with multiple disabilities. (Note: Two respondents identified as serving those with health impairment. They were excluded from the final analysis because they do not serve the population of interest studied here (those with intellectual disabilities).

Pre-to Post-Election and Respondent Differences

We first ran t-tests to explore potential differences between respondents before and after the election. All p’s were non-significant and ranged from .13–.99. Given that there were no meaningful differences between these groups of respondents, we collapsed all responses into one sample. Tests of provider roles revealed only two significant associations. First, when asked if clients asked if they want to vote there was an association, X²(2) = 25.09, p = .002, examination of the standardized residuals suggested that Other Professionals were more likely to select “less than 25% of the time” and less likely to select “none.” Second, when asked if they had contacted Wyoming Protection and Advocacy Services, there was also an association, X²(2) = 7.20, p = .027. Examination of the standardized residuals suggested that Direct Support providers were more likely to select “Don’t Know” than those in other roles. There were no other significant association by role.
TABLE 1

Demographics

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Total</th>
<th>Respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–29</td>
<td>6.2% (7)</td>
<td>6.9% (6)</td>
</tr>
<tr>
<td>30–39</td>
<td>21.2% (24)</td>
<td>26.4% (23)</td>
</tr>
<tr>
<td>40–49</td>
<td>25.7% (29)</td>
<td>28.7% (25)</td>
</tr>
<tr>
<td>50+</td>
<td>46.9% (53)</td>
<td>37.9% (33)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>83.2% (94)</td>
<td>83.9% (73)</td>
</tr>
<tr>
<td>Male</td>
<td>16.8% (19)</td>
<td>16.1% (14)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school graduate</td>
<td>27.4% (31)</td>
<td>27.6% (24)</td>
</tr>
<tr>
<td>Undergraduate degree</td>
<td>35.4% (40)</td>
<td>36.8% (32)</td>
</tr>
<tr>
<td>Graduate degree</td>
<td>31.9% (36)</td>
<td>28.7% (25)</td>
</tr>
<tr>
<td>Other</td>
<td>5.3% (6)</td>
<td>6.9% (6)</td>
</tr>
<tr>
<td>Participant Role</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct support personnel</td>
<td>40.7% (46)</td>
<td></td>
</tr>
<tr>
<td>Medicaid waiver case manager</td>
<td>16.8% (19)</td>
<td></td>
</tr>
<tr>
<td>Parent/guardian/family</td>
<td>22.1% (25)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>20.4% (22)</td>
<td></td>
</tr>
<tr>
<td>Years of Experience in Disability Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–2 years</td>
<td>4.4% (5)</td>
<td>5.7% (5)</td>
</tr>
<tr>
<td>3–5 years</td>
<td>8.0% (9)</td>
<td>10.3% (9)</td>
</tr>
<tr>
<td>5+ years</td>
<td>16.8% (19)</td>
<td>20.7% (18)</td>
</tr>
<tr>
<td>10+ years</td>
<td>70.8% (80)</td>
<td>63.2% (55)</td>
</tr>
<tr>
<td>Severity and Type of Disability of Individuals Primarily Served (or of child)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild intellectual disability</td>
<td>12.4% (14)</td>
<td>5.7% (5)</td>
</tr>
<tr>
<td>Moderate to severe intellectual disability</td>
<td>31.3% (34)</td>
<td>32.2% (28)</td>
</tr>
<tr>
<td>Multiple disabilities</td>
<td>48.7% (55)</td>
<td>54.0% (47)</td>
</tr>
<tr>
<td>Health impairment</td>
<td>1.8% (2)</td>
<td>2.3% (2)</td>
</tr>
<tr>
<td>All of the above</td>
<td>3.5% (4)</td>
<td>4.6% (4)</td>
</tr>
<tr>
<td>Other</td>
<td>3.5% (4)</td>
<td>1.1% (1)</td>
</tr>
<tr>
<td>Type of Disability Served (or of Child)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Majority have a physical disability</td>
<td>36.3% (41)</td>
<td>42.5% (37)</td>
</tr>
<tr>
<td>The majority have a health impairment separate from their disability</td>
<td>30.1% (34)</td>
<td>31% (27)</td>
</tr>
<tr>
<td>The majority have a mental health or substance abuse issue</td>
<td>20.4% (23)</td>
<td>23% (20)</td>
</tr>
<tr>
<td>None of the above</td>
<td>33.6% (38)</td>
<td>24.1% (21)</td>
</tr>
</tbody>
</table>

Responses to Open Ended Questions

The sample of respondents in this study generally expressed supportive beliefs regarding individuals with intellectual disability engaging in the voting process. However, the results also highlighted a number of barriers preventing those with intellectual disability from performing this civic action. Table 2 shows the response frequencies of each item. (Note: The topics or themes used to group responses were based on frequency of responses.)

When presented with the statement, “People with ID cannot be expected to provide a meaningful vote,” the majority of respondents selected some degree of disagreement. A slight fraction (6%) indicated agreement or strong agreement with the statement. Participants were provided an option to write an open-ended response to describe what influences their belief about the importance or unimportance of teaching consumers to vote. While some respondents expressed that vot-
TABLE 2
Survey Results

<table>
<thead>
<tr>
<th>Item</th>
<th>Frequency</th>
<th>%</th>
<th>Central Tendency (Ordinal Only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often consumers express desire to learn to vote?</td>
<td>None</td>
<td>24</td>
<td>27.9</td>
</tr>
<tr>
<td></td>
<td>Less than 25%</td>
<td>42</td>
<td>48.8</td>
</tr>
<tr>
<td></td>
<td>About 50%</td>
<td>8</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>Most</td>
<td>9</td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td>Do you know if voting was discussed at home?</td>
<td>Yes</td>
<td>47</td>
<td>54.7</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>35</td>
<td>40.7</td>
</tr>
<tr>
<td></td>
<td>Don’t Know</td>
<td>4</td>
<td>4.7</td>
</tr>
<tr>
<td>How often have guardians/parents requested voting instruction</td>
<td>None</td>
<td>47</td>
<td>54.7</td>
</tr>
<tr>
<td></td>
<td>Less than 25%</td>
<td>31</td>
<td>36.0</td>
</tr>
<tr>
<td></td>
<td>About 50%</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>Most</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td>How many consumers know what voting is</td>
<td>None</td>
<td>12</td>
<td>14.0</td>
</tr>
<tr>
<td></td>
<td>Less than 25%</td>
<td>30</td>
<td>34.9</td>
</tr>
<tr>
<td></td>
<td>About 50%</td>
<td>15</td>
<td>17.4</td>
</tr>
<tr>
<td></td>
<td>Most</td>
<td>20</td>
<td>23.3</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>9</td>
<td>10.5</td>
</tr>
<tr>
<td>Do you believe instructional materials allow consumers to understand political issues?</td>
<td>Unlikely except in rare cases</td>
<td>7</td>
<td>8.1</td>
</tr>
<tr>
<td></td>
<td>Not at all, concepts are too abstract.</td>
<td>6</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>Materials for important issues can be developed</td>
<td>16</td>
<td>18.6</td>
</tr>
<tr>
<td></td>
<td>Appropriate materials can be developed about political issues</td>
<td>57</td>
<td>66.3</td>
</tr>
<tr>
<td>How many of your consumers are registered to vote?</td>
<td>None</td>
<td>25</td>
<td>29.1</td>
</tr>
<tr>
<td></td>
<td>Less than 25%</td>
<td>36</td>
<td>41.9</td>
</tr>
<tr>
<td></td>
<td>About 50%</td>
<td>5</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>About 75%</td>
<td>14</td>
<td>16.3</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>6</td>
<td>7.0</td>
</tr>
<tr>
<td>How often have consumers expressed interest in voting?</td>
<td>None</td>
<td>33</td>
<td>38.4</td>
</tr>
<tr>
<td></td>
<td>Less than 25%</td>
<td>39</td>
<td>41.9</td>
</tr>
<tr>
<td></td>
<td>About 50%</td>
<td>6</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>About 75%</td>
<td>6</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>5</td>
<td>5.8</td>
</tr>
<tr>
<td>How often have you assisted consumers to register to vote?</td>
<td>Never</td>
<td>24</td>
<td>27.9</td>
</tr>
<tr>
<td></td>
<td>Just a few times</td>
<td>43</td>
<td>50.0</td>
</tr>
<tr>
<td></td>
<td>On occasion</td>
<td>11</td>
<td>12.8</td>
</tr>
<tr>
<td></td>
<td>Often</td>
<td>8</td>
<td>9.3</td>
</tr>
<tr>
<td>How often is voting included in consumers’ Individualized Service Plan (ISP)</td>
<td>None</td>
<td>13</td>
<td>15.1</td>
</tr>
<tr>
<td></td>
<td>Less than 25%</td>
<td>4</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>About 50%</td>
<td>4</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>About 75%</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>Don’t know</td>
<td>62</td>
<td>72.1</td>
</tr>
<tr>
<td>Have you provided instruction on how to vote to your consumers?</td>
<td>Never</td>
<td>7</td>
<td>8.1</td>
</tr>
<tr>
<td></td>
<td>Not very often</td>
<td>8</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>Occasionally</td>
<td>30</td>
<td>34.9</td>
</tr>
<tr>
<td></td>
<td>Frequently</td>
<td>19</td>
<td>22.1</td>
</tr>
<tr>
<td></td>
<td>All of our clients receive such instruction</td>
<td>22</td>
<td>25.6</td>
</tr>
<tr>
<td>Item</td>
<td>Frequency</td>
<td>%</td>
<td>Central Tendency (Ordinal Only)</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td>----</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Have your consumers ever been shown polling places?</td>
<td>None</td>
<td>16</td>
<td>18.6</td>
</tr>
<tr>
<td></td>
<td>Less than 25%</td>
<td>6</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>About 50%</td>
<td>14</td>
<td>16.3</td>
</tr>
<tr>
<td></td>
<td>About 75%</td>
<td>29</td>
<td>33.7</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>8</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>Don’t Know</td>
<td>13</td>
<td>15.1</td>
</tr>
<tr>
<td>How many consumers have been legally disenfranchised (declared legally incompetent/prevented from voting)?</td>
<td>None</td>
<td>26</td>
<td>30.2</td>
</tr>
<tr>
<td></td>
<td>Less than 25%</td>
<td>7</td>
<td>8.1</td>
</tr>
<tr>
<td></td>
<td>About 50%</td>
<td>5</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>About 75%</td>
<td>11</td>
<td>12.8</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>5</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>Don’t know</td>
<td>32</td>
<td>37.2</td>
</tr>
<tr>
<td>People with ID cannot be expected to provide a meaningful vote.</td>
<td>Strongly Disagree</td>
<td>37</td>
<td>43.0</td>
</tr>
<tr>
<td></td>
<td>Disagree</td>
<td>28</td>
<td>32.6</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>16</td>
<td>18.6</td>
</tr>
<tr>
<td></td>
<td>Agree</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Strongly Agree</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td>Teaching consumers to vote is a worthwhile objective.</td>
<td>Strongly disagree</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>Disagree</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>16</td>
<td>18.6</td>
</tr>
<tr>
<td></td>
<td>Agree</td>
<td>36</td>
<td>41.9</td>
</tr>
<tr>
<td></td>
<td>Strongly agree</td>
<td>33</td>
<td>34.4</td>
</tr>
<tr>
<td>Rank order the following barriers to voting based on their relative influence (1 is most important)</td>
<td>Lack of instruction</td>
<td>1</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>21</td>
<td>24.4</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>14</td>
<td>16.3</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>5</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>4</td>
<td>4.7</td>
</tr>
<tr>
<td>Lack of interest</td>
<td>1</td>
<td>28</td>
<td>32.6</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>33</td>
<td>38.4</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>13</td>
<td>15.1</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>4</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>8</td>
<td>9.3</td>
</tr>
<tr>
<td>Lack of parent/guardian interest</td>
<td>1</td>
<td>14</td>
<td>16.3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>27</td>
<td>31.4</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>25</td>
<td>29.1</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>10</td>
<td>11.6</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>10</td>
<td>11.6</td>
</tr>
<tr>
<td>Lack of transportation to polling place</td>
<td>1</td>
<td>11</td>
<td>12.8</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>11</td>
<td>12.8</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>15</td>
<td>17.4</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>16</td>
<td>18.6</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>33</td>
<td>38.4</td>
</tr>
<tr>
<td>Inaccessible polling place</td>
<td>1</td>
<td>5</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10</td>
<td>11.6</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>17</td>
<td>19.8</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>22</td>
<td>25.6</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>32</td>
<td>37.2</td>
</tr>
<tr>
<td>If you provide instruction, what is the focus on? (check all that apply)</td>
<td>National issues</td>
<td>48</td>
<td>55.8</td>
</tr>
<tr>
<td></td>
<td>Wyoming issues</td>
<td>45</td>
<td>52.3</td>
</tr>
<tr>
<td></td>
<td>Local issues</td>
<td>48</td>
<td>55.8</td>
</tr>
<tr>
<td></td>
<td>Voting process</td>
<td>54</td>
<td>62.8</td>
</tr>
</tbody>
</table>
ing is a right that should not be denied under any circumstances, such as “every individual has a right to vote and chose [sic] not to vote if they wish in our country regardless of dis
ability,” others qualified their responses based upon degree of disability or perceptions of competency. For example, one participant stated, “I feel that being able to vote is based on the individual’s degree of knowledge and capacity for learning. I do not feel that individuals with severe intellectual delay can make informed choices, but many high functioning individuals can.” Other respondents described voting as an essential means of political representation for those with intellectual to have a voice in informing policy affecting their lives. One individual explained:

_I believe [voting] is important [for those with intellectual disability] because there are governmental policies and programs that directly and indirectly affect their lives (and the services they receive). Having a basic understanding or even limited knowledge about this, and being able to vote on those issues, is important to their autonomy._

Several providers stated that clients do not possess sufficient competency to make informed-decisions due to their disability. One such participant asserted:

_The voting process is difficult for them to understand and the voting process is very confusion [sic] for them. The comprehension for the voting process on the whole is not something they can understand or make the decision needed for the political views and the people running for office._

Despite variation in their responses and degree of support, participants generally agreed that those with intellectual disability can provide a meaningful vote. Similarly, many believed that instruction for voting is possible for their consumers with intellectual disability. A majority of respondents (76%) agreed or strongly agreed that “teaching consumers to vote is a worthwhile objective,” while only one respondent (1.2% of the sample) strongly disagreed. Open-end responses represented this belief with statements such as, “if an issue is important to a person, I believe there must be a way to make it relative.” A similar majority (77%) of respondents agreed or strongly agreed that political issues or campaign information can be explained to people with intellectual disability, while an even larger majority (85%) identified that some form of instructional material can be developed to allow their clients to understand political issues. One participant described her belief as follows: “if all sides of the major issues are truly explained at

<table>
<thead>
<tr>
<th>Item</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do you support voting for your consumers?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2 responses missing)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I take them to polling place</td>
<td>No</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>32</td>
</tr>
<tr>
<td>I help them register to vote</td>
<td>No</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>31</td>
</tr>
<tr>
<td>We discuss political issues</td>
<td>No</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>48</td>
</tr>
<tr>
<td>We watch TV programs about voting</td>
<td>No</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>21</td>
</tr>
<tr>
<td>I inquired about their interest in voting</td>
<td>No</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>49</td>
</tr>
<tr>
<td>None of these</td>
<td>No</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>21</td>
</tr>
<tr>
<td>Political platforms or campaign information can be presented/explained to those with IDD.</td>
<td>Strongly disagree</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Disagree</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Agree</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Strongly agree</td>
<td>24</td>
</tr>
</tbody>
</table>

TABLE 2—(Continued)
an individual’s [sic] level of understanding they really do make very good informed choices.”

**Barriers to Voting**

While a majority of the respondents denoted supportive beliefs regarding voting for individuals with intellectual disability, a number of barriers were identified in their responses. When asked to rank a set of five defined barriers to voting based on importance, a majority selected lack of instruction (73%) and lack of consumer interest (71%) within the top two greatest barriers. However, it should be noted that a higher rate (48%) specified that instruction was the greatest barrier, whereas only a third (33%) selected the issue of consumers’ lack of interest as the greatest. Lack of parent/guardian interest was rated the third highest as a barrier, with half (48%) viewing it as one of the top two most significant barriers. Fewer respondents (26% and 17%, respectively) believed lack of transportation to polling places and inaccessible polling places were the two most impactful barriers. The three highest ranked barriers are discussed in light of the descriptive data from the survey, while an additional theme, i.e., uncertainty regarding the contexts for support, was added to address a fourth barrier identified within the results.

**Lack of instruction.** The most significant barrier to voting identified by respondents was a dearth of instruction for those with intellectual disability to engage in the voting process. Half (49%) of the respondents indicated that less than a quarter of their consumers knew what voting was, while half (51%) indicated that between 50% and all of their consumers have this knowledge. Participants in the study reported providing moderate degrees of instruction to consumers, with about half (48%) either frequently delivering instruction or acknowledging that all their consumers receive instruction. However, many providers in this sample indicated that they rarely assisted consumers to register to vote with half (50%) doing so just a few times and over a quarter (28%) never providing such support. Nearly three quarters (71%) of respondents specified that less than a quarter of their clients are registered to vote.

Of those who did provide instruction, respondents were asked to indicate all of the areas in which they focused attention. These participants focused similar degrees of attention on national issues (56%), state issues (52%), and local issues (56%), with slightly more providing instruction on the voting process (63%). Of the total sample, a slight majority (57%) reported discussing political issues with their clients as a form of support for their clients to vote and just over a third (38%) of the total sample indicated that they take their clients to a polling place as a means of assistance.

When participants were provided an opportunity to articulate their thoughts to the open-ended question, “If we wanted to increase the turnout of voters with intellectual disabilities in the state, what might be done?” the respondents identified a need for instruction in their responses. Some respondents discussed that more accessible opportunities for learning are needed; specifically, individuals with intellectual disability should have “more appropriate instruction and chances of learning how the process works and how to draw their own opinions regarding candidates based on each individual’s [sic] level of learning.” Others advocated for support staff to have the opportunity to learn how to offer instruction, such as a need to “provide training to DD Waiver case managers & providers along with providing easily understandable, non-biased information for their clients.”

**Perceptions of low client interest.** The second highest ranked barrier that respondents identified was consumers’ lack of interest in voting. While a slight majority (58%) reported inquiring about their consumers’ interest in voting as a form of support in the process, a majority (80%) denoted that fewer than a quarter of their total number of consumers had expressed an interest. A similar majority (77%) of respondents indicated that less than a 25% of their consumers have expressed a desire to learn to vote.

**Lack of parent/guardian interest.** The third most significant barrier that respondents ranked was lack of parent/guardian interest. While a slight minority (41%) of respondents claimed that voting was discussed in consumers’ home, a vast majority (91%) identified that less than 25% of their consumers’ par-
ents or guardians requested voting instruction for their children or the individuals they supported. In open-ended responses, the respondents provided several suggestions to increase voter turnout among those with intellectual disability, including fostering more parent, guardian, and programmatic engagement. As one respondent stated, there is a necessity to “spread awareness to providers and institutions, parents, and educators” and another suggested the importance of “get[ting] the parent/guardian/school involved in teaching/educating the people with intellectual disabilities.”

Uncertainty regarding the contexts for support. A majority of respondents (72%) were uncertain whether voting is included in consumers’ individualized service plan (ISP). Of those who designated they knew ($N = 24$), over half (54%) specified that none of their consumers have voting in their ISPs. Slightly over a third (37%) of the sample were unsure if consumers have been legally disenfranchised (declared legally incompetent and thus prevented from voting), while a little less than a third (30%) expressed that none of their consumers had been disenfranchised. The remaining third (33%) were fairly evenly split (between 6–12%) regarding how many of their consumers had been disenfranchised. In an open-ended response discussing increasing voter turnout, one respondent suggested to “make sure [voting] is a goal in [clients’] support plan and make sure each provider is part of this goal in order for the client to get a fair and full idea of voting.”

Discussion

The findings of this study contribute to the limited literature on the issue of voting for people with intellectual disability. The results highlight the perspectives of a sample of respondents regarding voting rights for this population and provide insight regarding the barriers preventing consumers from exercising their civic right to engage fully in the voting process.

While respondents generally indicated supportive beliefs for those with intellectual disability to participate in voting, the results identify a number of aspects preventing them from doing so. The most significant barrier selected by respondents was a lack of instruction, not only for those with intellectual disability, but also for their providers, families, and agencies to know how to support consumers in the voting process. In their open-ended responses, the respondents repeatedly identified a need for more accessible learning supports for consumers to understand the voting process, political issues, and candidate positions. Secondly, the sample specified a perception of low interest among of consumers to vote as a barrier. (Note: Whether consumers actually had a low interest was beyond the scope of this study.) Additionally, the sample identified a lack of parent and guardian interest as another obstacle to voting for consumers. Respondents also appeared to have uncertainty about the means of supporting consumers to vote. For example, a majority were unsure whether voting was included in their clients’ individualized service plan (ISP) and over a third did not know if their clients had been legally disenfranchised. Collectively, these barriers may provide insight as to why a majority of providers reported that fewer than 25% of their consumers were registered to vote.

Respondents were given the opportunity to discuss their perspectives on voting and people with intellectual disability through open-ended responses. While a significant majority specified some level of agreement that people with intellectual disability can provide a meaningful vote, written comments captured variation in degrees of support. While some expressed that assessments of competency and degree of intellectual disability should determine enfranchisement, others maintained that voting is a right that should not be denied to any citizen regardless of disability label. Others further identified voting as an important means of self-advocacy and political representation for those with intellectual disability to have a voice in impacting policies and programs affecting their lives.

The results of this study support similar findings from the limited research on the topic. A majority of respondents indicated that relatively few of their consumers (or children) with intellectual disability know what voting is, which is a similar finding of research examining political knowledge of those with learning disabilities (Bell & Horsler, 2003).
However, this present study cannot conclude whether this result is solely the perspective of the respondents or whether this observation accurately represents the lack of knowledge about voting of the consumers targeted in the sample. Lower rates of knowledge about voting does not prohibit members of the general population from voting, nor should it for people with intellectual disability. Nevertheless, this finding supports the need for those with intellectual disability to have access to more robust education about the voting process (Bell et al., 2001).

Of the respondents who were aware of whether voting was included in their consumers’ individualized service plans (ISP), over half specified that none of their consumers have it included. This limited use of the ISP to supporting replicates previous findings (Agran et al., 2015). Offering the opportunity for individuals to formalize support in their ISPs would facilitate those with intellectual disability to have greater engagement in the voting process (Willis et al., 2016). Providing information about voting in an accessible manner is the responsibility not of the individual with intellectual disability, but of the provider (Pavey, 2003). Ultimately, agency policies that support voter registration for consumers and assist them to engage in the voting process are likely to affect a positive voter turnout (Keeley et al., 2008).

This study suggests that some providers do attempt to provide instruction to their consumers, primarily in the form of discussing political issues. Respondents identified some of the different ways they provide this instruction, such as attending local meetings with political candidates, obtaining sample ballots, discussing the voting process, locating information on candidates, watching national conventions on television, and attending educational events put on by the state Protection & Advocacy. Previous research suggests that adults with intellectual disability are more likely to vote when they have a supportive network of people, including both family and non-family members with whom they can have political discussions and who support them in the voting process (Kjellberg & Hemmingsson, 2013). Such instructional supports surrounding voting may be important considerations to consider in efforts aimed at increasing voter turnout. Guidance on teaching techniques to educate consumers about the voting process is necessary to ensure providers relay information in an accessible manner (Willis et al., 2016). This need was also identified by the providers in the sample, as in the words of one respondent, “I don’t believe that providers are often instructed on how to talk with participants about voting.”

Individuals with intellectual disability can use accommodations throughout the process to ensure voting is accessible and providers can play a key role in ensuring this (Jordan & Dunlap, 2001). Respondents identified that accommodations may include having someone read the ballot who is a “person they feel comfortable with and not a stranger”, “doing mock elections with mock voting booths”, and “develop[ing] tools that can assist with teaching about the issues in a non-partisan way in an easy to understand, simple format.” Accommodations allow the individual to vote as independently as possible, including assistance with reading or completing their ballot (Bell et al, 2001) or having the opportunity to vote by absentee ballot (Matsubayashi & Ueda, 2014; Tokaji & Colker, 2007). Materials should provide pictures, not overcrowd text; use simplified diction and shorter sentences; and state the issue with the policy response as clearly as possible (Pavey, 2003). Accessible, readily available materials can assist with educating individuals with intellectual disability about voting, such as providing non-partisan information on candidates and instruction on how to cast a ballot (Shields et al., 1998). Additionally, instructional materials to educate poll workers can be developed to outline the ways in which election officials may provide assistance to those with disabilities to vote as well as address how poll workers may not deny a registered voter access based on individual perceptions (see the U.K.’s Handbook for Polling Station Staff [The Electoral Commission, 2017].).

Given the barrier of provider uncertainty regarding the means for providing voting support, providers (and guardians/parents) may need to build awareness and knowledge about how they can support individuals to vote. When individuals are assigned guardians, it does not necessarily result in the individual losing his or her right to vote, although this
distinction and legal specification varies by state (Schriner & Ochs, 2000). Providers may contact their state Protection and Advocacy System to receive education regarding state law (Administration on Community Living, 2017). However, it should be noted that scholars have called into question the ethics of legal barriers to voting; citing both violations of the constitution (Redley et al., 2012) and of human rights (Schriner & Ochs, 2000). Nuances in guardianship law are important to understand because misunderstandings can lead to illegally preventing individuals from voting, given that under state law, a person must usually receive a court ruling of legal incompetence to be restricted (Jordan & Dunlap, 2001). Previous research has demonstrated service professional misunderstanding of their client rights regarding voting (Bell et al., 2001) and future studies should investigate this theme further.

Written respondent comments suggest that people who support those with intellectual disability are sometimes considering their personal assessments of competence of individuals as an important determinant for voting rights. As indicated by one respondent, “I feel that being able to vote is based on the individual’s degree of knowledge and capacity for learning.” Better enforcement of policy rights protections could be an important step toward reducing the attitudinal barriers those with disabilities face in participating fully in the voting process (Schur & Adya, 2012; Ward et al., 2009). This study contributes to identifying both education and enforcement as an important means of protecting a key civil right of citizenship for Americans with intellectual disability.

This study contributes to the limited literature on how people with intellectual disability are sometimes considering their personal assessments of competence of individuals as an important determinant for voting rights. As indicated by one respondent, “I feel that being able to vote is based on the individual’s degree of knowledge and capacity for learning.” Better enforcement of policy rights protections could be an important step toward reducing the attitudinal barriers those with disabilities face in participating fully in the voting process (Schur & Adya, 2012; Ward et al., 2009). This study contributes to identifying both education and enforcement as an important means of protecting a key civil right of citizenship for Americans with intellectual disability.

This study contributes to the limited literature on how people with intellectual disability participate in and are supported in the voting process. It continues an investigation into the voting behavior, supports, and barriers experienced by those with intellectual disability (see Agran & Hughes, 2013; Agran et al., 2015; Agran et al., 2016). Results replicate similar findings to the Agran et al. (2016) study, including respondent identification of generally low rates of voter registration, low rates of inclusion of voting in service plans, and perceptions of low interest in voting among clients. The intent of the present study was not to provide prevalence data, i.e., a count or estimate of the number of people in a sample who vote, but to extend the conversation about a topic we believed has received limited attention. Also, since it is well acknowledged that the 2016 presidential election was highly contentious, we believed that this historical effect could potentially have affected the study’s findings. However, as the findings revealed, this did not appear to be the case.

While this study had a larger sample than Agran et al. (2015), similar limitations as reported in the Agran et al. study were present. The study represented a relatively small sample within a single state. Future research should examine larger samples in geographically diverse regions of the United States. Also, since the survey was accessible via an online survey link we do not know the relative size of the potential pool of respondents. Although we believe the findings contribute to the disability-related literature, we realize that the lack of a larger sample compromises the generalizability of the findings. Future replications to states with larger populations are needed.

Further, the respondents in this sample served consumers, or were parents of individuals with intellectual disability, who no doubt had a broad range of skill levels and abilities. Although the intent of the study was not to examine the findings specific to varying degrees of intellectual disability, future research is warranted to examine this relationship, that is, voter participation relative to severity of intellectual disability. Such information would be of value in identifying and accommodating learning needs. Additionally, the present study did not assess actual voter participation or registration rates of those with intellectual disability, but rather secured knowledge from a sample of service providers, case managers, or parents/guardians. While these respondents represent an important stakeholder group, future research should continue to elicit the perspectives of adults with intellectual disability (see Agran et al., 2016) to ensure their voices, self-advocacy, and perspectives regarding the voting process are integrally incorporated in informing the instruction and policy around voting. Self-advocates may be solicited for their ideas about...
how professionals, family members, election officials, and local and federal policies can best support them to vote. Last, a broad range of respondents was recruited. Given the limited research about voting, our intent was to secure as much input as possible appropriate to the objectives of the study. Although we presented a general picture of the stakeholders’ opinions and perspectives, we did not disaggregate the data specific to the respondents’ roles. There is no doubt that some of the respondents had closer “working” relations than other respondents, but the extent and nature to which they did were not captured in our findings. An appropriate follow-up to the present study would be to examine this issue.

Despite the above-mentioned limitations, we believe the present study contributes to our increased recognition that relatively few adults with intellectual disability vote—arguably, our most important civil right. With increased recognition, greater efforts can be made to ensure enfranchised individuals with intellectual disability who wish to vote have the support to do so.

To increase voting participation of individuals with intellectual disability on a long-term basis, change needs to occur at various levels; specifically, improve individual competence (instruct consumers on how to vote); enhance public awareness that people with intellectual disability have the right and capacity to vote; and produce systemic change by ensuring that service agencies place more instruction on delivering voting instruction, and there is active encouragement in the media to promote voting among people with disabilities. Failure to affect change at each of these levels will produce limited and short-term effects. Given the magnitude of the problem, concentrated efforts must be made by all stakeholders (e.g., service agencies, parents/guardians, educators, political parties) to correct the problem. Last, there is little reported research on the specific reasons why people with intellectual disability are either excluded from voting (e.g., legal determination of disenfranchisement, lack of acceptable identification) or believe they are being excluded. Such information would be of great value in helping to increase voter turnout.

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Development of the Self-Determined Learning Model of Instruction Coaching Model: Implications for Research and Practice

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Abstract: The Self-Determined Learning Model of Instruction (SDLMI) is an evidence-based model of instruction implemented by a facilitator (e.g., general or special education teacher, family member, related service professional, transition professional) to enable students to learn to self-regulate problem solving in service to a goal. Students learn how to select personally relevant goals, develop action plans for achieving those goals, and self-monitor and self-evaluate progress toward achieving those goals. To scale-up the implementation of the SDLMI with fidelity by facilitators, there is a need for a systematic coaching model. Researchers have established coaching as a critical aspect of the implementation of evidence-based practices at scale and as a part of ongoing professional development. The purpose of this article is to describe steps taken to develop a systematic coaching model to support the implementation of the SDLMI. We will describe components of the SDLMI Coaching Model and the process through which they were derived from the coaching literature and data gathered during SDLMI research studies. We will conclude with implications for the implementation of the SDLMI Coaching Model at scale while maintaining a focus on individual students’ support needs.

Causal Agency Theory provides an empirically-validated framework for conceptualizing the development of self-determination across the lifespan. Causal Agency Theory defines self-determination as a “dispositional characteristic manifested as acting as the causal agent in one’s life. Self-determined people (i.e., causal agents) act in service to freely chosen goals” (Shogren, Wehmeyer, Palmer, Forber-Pratt et al., 2015, p. 258). Self-determination develops across the lifespan as children and youth have opportunities to build skills and attitudes associated with self-determined actions including choice-making, decision-making, problem solving, goal setting and attainment, planning, self-management, self-advocacy, self-awareness, and self-knowledge (Shogren, Wehmeyer, Palmer, Forber-Pratt et al., 2015).

The positive impact of promoting self-determination on in-school (e.g., academic achievement, goal attainment; Shogren et al., 2012) and post-school (e.g., employment, community participation; Shogren, Wehmeyer, Palmer, Rifenbark, & Little, 2015) outcomes has been confirmed by multiple research studies (Hagiwara et al., 2017). As such, in both general and special education, there is a growing emphasis on promoting the skills associated with self-determination in inclusive environments aligned with efforts to promote social-emotional learning and college and career readiness (Shogren et al., 2016). Researchers have established teachers can embed instruction in skills associated with self-determination into academic and transition-related content, leading to enhanced self-determination and goal attainment (Powers et al., 2012; Test et al., 2009). However, teachers have also identified the need for further support for implementation, particularly as re-
search project-based supports fade. This lead to the activities undertaken to create the SDLMI Coaching Model.

Self-Determined Learning Model of Instruction

The Self-Determined Learning Model of Instruction (SDLMI; Shogren et al., 2019) is an evidence-based practice (National Technical Assistance Center on Transition, 2017) designed to embed instruction on self-determination in ongoing curricular activities. The SDLMI is designed to be implemented by a facilitator (e.g., general or special education teachers, career counselors, transition specialists). Facilitators enable students to learn and practice skills associated with self-determination, by providing explicit instruction (e.g., how to make choices, set goals, plan) and embedding opportunities to practice those skills in ongoing instruction to ultimately teach students to self-regulate problem solving in service to a goal. As such, general or special education teachers can use the SDLMI to shape their instruction and teach students how to set and attain goals that are linked to the general education curriculum or students’ individualized learning plans, including transition planning. The SDLMI can be implemented with students with and without disabilities, in whole-class, small group, or one-to-one settings. Essentially, the SDLMI was designed as a model of instruction that could be overlaid on any curricular area to support teachers in enabling students to set and work toward goals in that curricular area (Shogren et al., 2019).

The SDLMI consists of a three-phase instructional process repeated over time to enable students to work on setting and attaining goals that build on and enhance each other (see Figure 1). Each of the three instructional phases includes four Student Questions that guide students through the problem-solving steps needed to solve the overarching question of each phase (Phase 1: What is my goal?, Phase 2: What is my plan?, Phase 3: What have I learned?). The solution to the problem in each phase leads to the problem-solving sequence in the Student Questions in the next phase. Importantly, each Student Question is linked to a set of Teacher Objectives that provide teachers or other facilitators with a road map for how they can organize instruction to enable students to answer each Student Question. The Teacher Objectives drive teachers’ instructional practices and actions and are linked to Educational Supports, which are strategies teachers can use to meet the specified objective based on students’ individualized learning needs. Teachers deliver targeted instruction on these strategies to support students in answering the Student Questions. Additionally, teachers integrate the identified goal and action plan into ongoing instructional activities by embedding opportunities for students to apply learned skills in service to their goals. For example, a student might set a goal to ensure they have provided the format of a solution in math class (e.g., most simplified version) by underlining the directions on homework, quizzes and tests. To support the student in achieving their goal and implementing their action plan, the teacher can refer to this goal during core content instruction as well as deliver targeted instruction en-

Figure 1. The phases of the SDLMI. © 2017 – Kansas University Center on Developmental Disabilities, Lawrence, KS USA.
abling the student to develop a system that prompts them to underline the directions before each beginning each assignment.

In a recent, systematic literature review of the SDLMI studies, Hagiwara and colleagues (2017) found that all 21 SDLMI studies produced positive students outcomes (e.g., enhanced self-determination, increased access to the general education curriculum, improved classroom behavior, student-directed transition planning). However, only eight out of the studies identified in the literature that were implemented by teachers and/or other facilitators reported the characteristics of initial training and ongoing technical assistance activities to support the implementation of the SDLMI. For example, Shogren et al. (2012) and Wehmeyer et al. (2012) reported that teachers were trained for 0.5 to 1.5 days prior to implementation and supported through ongoing email support. However, no ongoing, systematic training, professional development, or coaching were delivered. Cho et al., (2011) found that teachers reported a lack of formal training in interventions to promote self-determination as one of the most significant barriers to implementing instruction to enhance self-determination in general and special education. In a recent statewide SDLMI implementation (Shogren et al., 2018), efforts were undertaken to provide teachers with more systematic implementation supports, including coaching and yearly professional development. While coaching played a major role in supporting the teachers to implement the SDLMI with fidelity in this project, the coaching was delivered relatively informally and varied across participating districts when evaluated from the lens of implementation science (Burke et al., 2019). Therefore, researchers recommended establishing a systematic coaching model to ensure that high-quality, consistent coaching is delivered across coaches and their assigned facilitators. Furthermore, researchers suggested improving the coaching system by: (a) asking teachers for feedback on their coaching experiences and (b) establishing a strong, integrated fidelity assessment system to addresses teacher practices in the classroom and coaching practices to ensure high quality implementation (Burke et al., 2019).

**Development of the SDLMI Coaching Model**

The importance of coaching in promoting fidelity of implementation of an effective innovation has been widely acknowledged (Fixsen et al., 2005). Coaching also plays a key role in ensuring facilitators of an intervention to have the competencies to implement evidence-based practices as intended over time (Snyder et al., 2015). Additionally, researchers have identified coaching as an effective way to provide face-to-face modeling and guidance on the use of interventions (Fixsen et al., 2010). For teachers and other facilitators to implement the SDLMI with fidelity, best practice recommends the importance of sustained and systematic supports throughout implementation (Fixsen et al., 2010). However, to date, there has not been a formalized written coaching service delivery model that could be utilized by schools to support the implementation of the SDLMI. To address this need, a team of researchers and practitioners, including the developers of the SDLMI, researchers who have developed frameworks for professional development and implementation supports for schoolwide applications, and practitioners with coaching experience, progressed through an iterative process to review the existing literature and develop the SDLMI Coaching Model.

There were two key areas of focus in the development of the SDLMI Coaching Model. First, we determined that the coaching model must reflect the theoretical framework upon which the SDLMI is based, Causal Agency Theory, with a focus on promoting self-regulated learning of all people involved in the SDLMI implementation (e.g., facilitators, students, family members, other school professionals). Second, we committed to aligning the coaching model with a model of instruction, like the SDLMI. According to Joyce and Weil (1980), a model of instruction is a plan to shape curriculums, to design instructional materials, and to guide instruction in classrooms. Unlike other existing teaching models that focus more on teacher actions, the SDLMI emphasizes the importance of providing “teachers direction to truly enable young people to become causal agents in their lives” (Wehmeyer et al., 2000, p. 440). Therefore, the SDLMI Coaching Model was designed to
align with the tenants of Causal Agency Theory as well as the unique characteristics of a model of instruction emphasizing student-direction of goals in the classroom. As such, we viewed the coaching model as having two primary purposes (a) to guide coaches to support facilitators in implementing the SDLMI with fidelity to systematize the coaching procedures for future research and practice and (b) to ensure that every student receives highly effective instruction through the SDLMI.

In the following sections, we describe the steps taken to develop a systematic model for SDLMI coaching and describe the components of the coaching model. First, we introduce definitions of coaching and the definition adopted for the SDLMI Coaching Model. Then, we describe each component of the SDLMI Coaching Model and associated theoretical and empirical rationales. These components include the SDLMI coaching framework, coaching stages, coaching procedural checklist, coaching fidelity measure, coaching conversation guides and notes, and coaching feedback survey (see Table 1 for an overview). We specifically focus on how the coaching framework and coaching stages are closely linked together (see Figure 2). Lastly, we provide suggestions for how the SDLMI Coaching Model can be further researched and implemented in various school contexts.

**Definitions of Coaching**

As mentioned previously, the team of researchers and practitioners partnered to develop the SDLMI Coaching Model. To lay the groundwork for its development, the team first sought to understand the variety of existing definitions of coaching in the education field. We conducted literature searches using the terms coaching and education, as well as sought recommendations from other researchers and implementers on coaching models. We reviewed the identified literature with a focus on the definition and procedures adopted for coaching to (a) determine relevance to SDLMI coaching and (b) identify

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
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<tbody>
<tr>
<td>1: SDLMI Coaching Framework</td>
<td>Composed of the six coaching principles and is intended to support coaches in providing effective coaching. It operationalizes actions associated with each principle.</td>
</tr>
<tr>
<td>2: SDLMI Coaching Stages</td>
<td>Coaching principles are actualized in practice through coaching tasks completed in four stages. The first occurs prior to an observation, the second stage during the observation and the last two stages (Reflect and Share) occur during the Coaching Session following the Coaching Observation.</td>
</tr>
<tr>
<td>3: SDLMI Coaching Procedural Checklist</td>
<td>Used by coaches to ensure the completion of all tasks associated with the SDLMI Coaching Model.</td>
</tr>
<tr>
<td>4: SDLMI Fidelity Measure</td>
<td>Completed by coaches to assess the extent to which the SDLMI is implemented with fidelity. After completing the measure during the Coaching Observation session, coaches use it to guide the conversation during the Coaching Session.</td>
</tr>
<tr>
<td>5a: SDLMI Coaching Conversation Guide</td>
<td>Provides an outline of topics to cover, suggested phrasing, and important reminders for coaches to have meaningful conversations with facilitators during coaching sessions.</td>
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<tr>
<td>5b: SDLMI Coaching Conversation Notes</td>
<td>Used to take notes based on the coaching conversation in a structured way.</td>
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<tr>
<td>6: SDLMI Coaching Feedback Survey</td>
<td>Provides facilitators an opportunity to anonymously provide feedback to improve future coaching practices. Facilitators receive a prompt to complete the survey in a follow-up email.</td>
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</table>
evidence-based practices to integrate in the SDLMI Coaching Model. As we quickly determined there were multiple definitions of and procedures for coaching in the literature, efforts were undertaken to synthesize key components across the various definitions with an emphasis on the relevance to SDLMI coaching. During the exploration of the definitions of coaching and associated practices, we generated matrices of definitions and practices to review as the team and identified commonalities and overlaps with the SDLMI philosophy.

Our rationale for focusing on similarities across definitions and practices was to identify the key elements across coaching definitions and practices that could be used to inform the SDLMI Coaching Model. For example, in the early childhood context, Winton et al. (2008) defined coaching as "an interactive process of reflection and feedback that provides support and encourages the person being coached to refine existing practices, develop new skills, and promote continuous self-assessment and learning" (p. 229). According to Rush and Shelden (2011) who are also experts in early childhood, the purpose of coaching is to support families and practitioners while acknowledging and improving "existing knowledge and practices, develop new skills, and promote continuous self-assessment and learning" (p. 3). Knight (2009) defined coaching as partnering with teachers to support them to "incorporate research-based instructional practices into their teaching so that students will learn more effectively" (p. 18). Moreover, Snyder and colleagues (2015) defined practice-based coaching as "a cyclical process for supporting preschool practitioners’ use of effective teaching practices that leads to positive outcomes for children" (p. 134) and explained that such coaching was job-embedded and targeted to support practitioners to implement evidence-based practices with fidelity. Practice-based coaching has been studied with different instructional practices and shown effects on teachers’ fidelity of implementation (Snyder et al., 2015).

In synthesizing these definitions, we identified commonalities across definitions, including a focus on (a) supporting practitioners to learn to implement an evidence-based practice by building on their existing knowledge and skills and (b) enabling practitioners to self-reflect on their progress towards independently performing the newly introduced practice for benefit of students. We also identified key elements from two definitions that were highly relevant to the SDLMI; specifically, the partnership element between a coach and a teacher proposed by the Knight’s (2009) coaching definition and the practice-based element defined by Snyder and colleagues’ (2015) coaching model.
Building on these findings, we generated a purpose statement for the SDLMI Coaching Model: to ensure sustainable, systematic, and ongoing supports for facilitators so that they can improve their knowledge and skills in implementing the SDLMI with fidelity to benefit students’ learning. Moreover, we came to realize the criticality of defining coaching not as a one-way interaction but as a two-way interaction requiring dialogue exchange through a cyclical process where coaches supported facilitators in all aspects of intervention implementation. This emphasis was intentionally embedded throughout the SDLMI Coaching Model.

**SDLMI Coaching Framework**

After generating the purpose statement and definition of coaching for the SDLMI Coaching Model, we shifted our focus to creating a coaching framework that defined the specific practices that coaches would use to provide supports to SDLMI facilitators in a systematic manner. As a first step, we created principles that would be used to guide the actions taken by coaches in implementing the coaching model. We reviewed partnership principles of instructional coaching described by Knight (2011) and the seven family-professional partnership principles described by Turnbull et al., (2015). We focused on these frameworks as they both (a) are informed by research and practice and (b) focus on equality in partnerships. For these reasons, the principles fit with the theory undergirding the SDLMI and its implementation. We then compared the two sets of principles side-by-side, identifying commonalities and divergences. We found that equality and respecting and valuing others’ opinions were emphasized in both sets of the principles. We then iteratively reviewed the remaining principles that did not overlap, the core values of the SDLMI, and the implementation of a model of instruction to decide on the core elements that would guide the SDLMI Coaching Model. After the iterative process, we defined six SDLMI coaching principles: (a) application, (b) empowerment, (c) equality, (d) reflective dialogue, (e) shared vision, and (f) trust. The principle of trust is considered a cornerstone for implementing the SDLMI Coaching Model, as in the family-professional partnership model (Turnbull et al., 2015), but each principle must be equally considered and applied in implementing the SDLMI Coaching Model.

**SDLMI coaching framework principles.** The first principle of application emphasizes that the role of the coach is to support SDLMI facilitators to flexibly and creatively apply the skills and knowledge needed to implement the SDLMI with fidelity through meaningful and accessible examples and modeling of practices to build facilitator implementation competencies. The second principle of empowerment focuses on how coaches can situate facilitators as expert decision-makers through encouraging and supporting facilitators to innovate and actively engage in their own professional growth. Equality, the third principle, values communication and equal partnership between the coach and facilitator. To actualize this principle, coaches are to seek information and accommodate facilitators’ communication preferences and respect facilitators’ perspectives which can be influenced by their professional experiences and cultural backgrounds. The fourth principle of reflective dialogue emphasizes how coaches can promote facilitators’ reflection on SDLMI implementation through conversation. To do so, coaches need to first reflect their own beliefs, attitudes, and perspectives, and then engage in active and respectful listening to collaboratively identify strengths, implementation challenges, and useful supports for implementation. The fifth principle, shared vision, involves coaches establishing rapport and shared understanding with facilitators. Coaches are expected to establish expectations with facilitators for each parties’ roles, responsibilities, and outcomes and take action to meet and model expectations during and in-between coaching sessions. Coaches also emphasize that coaching is a shared learning opportunity for everyone to improve based on exchanging professional dialogue. Finally, the trust principle emphasizes the need for coaches to actualize all of the partnership principles in a way that builds strong, collaborative relationships that lead to enhanced student outcomes. The most important action for coaches in building trust is to be reliable and ethical with their words and actions, maintain confidentiality, and demonstrate professionalism in their in-
teractions with facilitators and other stakeholders, including students and other professionals.

**SDLMI Coaching Stages**

In order for coaches to actualize the SDLMI coaching principles in practice, we identified four stages of the SDLMI coaching process to guide and operationalize specific tasks that coaches lead during interactions with facilitators. The term, stages, was chosen to demonstrate the notion of cyclical coaching process as delivering coaching might not follow a direct, linear, step-by-step process, but it should be fluid and flexible based on the needs of facilitators and the progress of the SDLMI implementation. To identify the coaching stages, we reexamined the coaching literature (Artman-Meecher et al., 2015; Rush & Shelden, 2011; Snyder et al., 2015) to understand essential coaching tasks. We identified four common coaching stages: planning, observation, reflection, and feedback. After further discussion as a team and with the SDLMI coaching principle in mind, we decided the SDLMI coaching stages needed to include planning, observation, reflection, and sharing. The use of sharing instead of feedback was intended to emphasize the collaborative elements of the SDLMI coaching principles.

The four SDLMI coaching stages: (a) plan, (b) observe, (c) reflect, and (d) share each have three associated tasks for coaches to carry out. The first stage of plan occurs prior to an instructional observation session, which is when coaches observe facilitators implementing the SDLMI with their students. For example, during the planning stage, a coach communicates with a facilitator to set up an observation date and time and discuss the purpose and process of the SDLMI Coaching Observation. In the observe stage, the coach watches the facilitator implement the SDLMI while completing the SDLMI Fidelity Measure, which is intended to gather information on how teachers implement the SDLMI. The coach assesses the facilitator’s implementation of the SDLMI to enable students to answer Student Questions while the facilitator meets associated Teacher Objectives and embeds Educational Supports into instruction as needed. The final two stages occur after the observation when the coach and facilitator meet to review information obtained during the observation. In the reflect stage, the coach and the facilitator collaboratively identify the facilitator’s strengths and support needs related to the SDLMI implementation and develop an action plan for improving future implementation. At this time, the coach provides an opportunity for the facilitator to reflect on implementation and request supports or resources from the coach to enhance instruction further. During the share stage, the coach acknowledges and provides feedback on the facilitator’s efforts and progress toward promoting student self-determination. Additionally, both the coach and the facilitator set goals for the next coaching session and share responsibilities to accomplish prior to that session. Figure 2 demonstrates how the coaching principles are linked to the coaching stages as well as how the stages can take place concurrently as well as cyclically.

**SDLMI Coaching Procedural Checklist and Fidelity Measure**

**Procedural checklist.** To ensure coaches carry out tasks associated with the SDLMI coaching stages, we created a procedural checklist that lays out when and how each stage is expected to take place. For example, during the plan stage, coaches send an email to facilitators to introduce themselves (only for the first observation), explain the coaching process, and discuss details of an observation session, which is when coaches observe facilitators implementing the SDLMI with their students. For example, during the planning stage, a coach communicates with a facilitator to set up an observation date and time and discuss the purpose and process of the SDLMI Coaching Observation. In the observe stage, the coach watches the facilitator implement the SDLMI while completing the SDLMI Fidelity Measure, which is intended to gather information on how teachers implement the SDLMI. The coach assesses the facilitator’s implementation of the SDLMI to enable students to answer Student Questions while the facilitator meets associated Teacher Objectives and embeds Educational Supports into instruction as needed.

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**SDLMI Fidelity Measure.** We systematically planned for how the SDLMI Fidelity Measure would be used to support SDLMI implementation fidelity and strengthen the partnerships between the coach and the facilitator. According to Snyder and colleagues (2015), “the provision of job-embedded support is important for implementation fidelity” (p. 133); therefore, in the school context, coaches support facilitators (e.g., teachers) to use instructional practices in their classrooms and provide facilitators with opportunities to receive feedback on their performance and reflect on it (Snyder et al., 2015). The National Implementation Research Network (NIRN) describes three implementation drivers (competency, organization, and leadership) as essential supports for a program’s success (2015). The competency drivers relate to the training, ongoing supports (e.g., coaching), and the use of measures of fidelity that are designed to assess the outcomes of training and coaching and the use of the findings to improve skills related to training and coaching to enhance teacher implementation (NIRN, 2015).

In the statewide implementation of SDLMI described earlier, coaches observed during teacher implementation of the SDLMI, and after the observation, both coaches and teachers completed the same fidelity measure and discussed strengths and areas for improvement (Shogren et al., 2018). Although teachers and coaches filled out the same fidelity form, their ratings differed; therefore, Shogren and colleagues (2018) suggested making the fidelity measures align with roles of coaches and facilitators. This approach is supported by the implementation fidelity literature, and according to Carroll and colleagues (2007), the elements of fidelity include adherence to an intervention, exposure or dosage, quality of delivery, participant responsiveness, and program differentiation.

Therefore, as described by Shogren et al., (2020), we developed a new SDLMI Fidelity Measure to be completed by coaches or independent observers to evaluate fidelity of implementation. The SDLMI Fidelity Measure (Shogren & Raley, 2018) includes three sections: (a) observation information, (b) SDLMI lesson observation, and (c) content instruction observation. The observation information is collected prior to the observation to gather data on the SDLMI phase, targeted Student Question(s) and Teacher Objective(s), and the facilitator’s current perspectives on implementation. The SDLMI lesson observation is guided by 12 rating scale items with notes for reflections by the coach. The core content section allows the coach to examine the degree to which the facilitator embeds opportunities and instruction in content instruction. This section is guided by seven questions, for example, the coach is asked to rate the degree to which the facilitator mentions students’ goals and action plans or provides Educational Supports appropriate to students’ support needs.

**SDLMI Coaching Conversation Guide and Notes**

Following the observation and the completion of the SDLMI Fidelity Measure, the SDLMI coaching session takes place. This session can immediately follow the observation or be scheduled within a week and can occur in-person, via online conference or phone call. During this coaching session, the share and reflect stages are implemented. The SDLMI Coaching Conversation Guide was developed to guide the discussion during the coaching session. In the process of developing the SDLMI Coaching Conversation Guide, we integrated the SDLMI coaching principles and associated actions. The SDLMI Coaching Conversation Guides outlines the main topics to cover during the coaching session and includes important reminders and suggested phrases for coaches to use to encourage meaningful conversations with facilitators during coaching sessions. Having a guide for coaching conversations is important because this provides a way for “an effective coach [to provide] ‘craft’ information along with advice, encouragement, and opportunities to practice and use skills specific to the innovation (e.g. engagement, treatment, clinical judgment)” (NIRN, 2015, p. 12).

The SDLMI Coaching Conversation Guide is divided into the three sections: (a) opening, (b) facilitating, (c) closing. During the opening section, the coach is expected to establish rapport with the facilitator. During the facilitating section, the coach is expected to discuss the facilitator’s strengths in implementing the SDLMI, use of Educational Supports, and barri-
ers encountered. To close the discussion, the coach and the facilitator are expected to set shared goals and make an action plan to achieve the goals related to the SDLMI implementation. The SDLMI Coaching Conversation Guide includes a place for coaching conversation notes to record important information for future reference, such as the facilitator’s strengths and barriers during SDLMI implementation. Although we recognize the importance of the face-to-face coaching, regular communication via email can be considered part of coaching and maintaining a sense of partnership. Because performance-based feedback via email to support teachers’ use of recommended practices can be an effective method (Barton et al., 2018), we have designed the SDLMI Coaching Model so that coaches clearly understand when and how email should be used to strengthen communication and relationships.

SDLMI Coaching Feedback Survey

Finally, we developed a feedback survey to create a means for facilitators to anonymously provide feedback to improve future coaching practices. Following a coaching session, facilitators receive a prompt to complete the online survey through a follow-up email. This aligns with the share stage. The feedback survey was developed based on the coaching principles to allow facilitators to indicate the degree to which the coach actualized the principles in their interactions. The survey includes nine questions asking facilitators to indicate their disagreement/agreement with the item on a slider scale and also one open-ended question for additional feedback.

Discussion

The purpose of this article was to describe the steps taken to develop a systematic coaching model to support implementation of the SDLMI by facilitators in school contexts. The article described the components of the SDLMI Coaching Model and how they were derived from the coaching literature and previous SDLMI implementation. Documenting the systematic steps to develop the process is an important first step; however, a number of important questions need to be addressed in research and in practice to provide information on the feasibility of this process and the ability of coaches to implement it with fidelity.

Future Research and Practice Directions for the SDLMI Coaching Model

First, previous research has suggested coaching impacts implementation of the SDLMI and teacher and student outcomes (Shogren et al., 2018). However, previous efforts to deliver coaching for SDLMI implementation were not fully systematized (Burke et al., 2019), necessitating further research on the fully developed SDLMI Coaching Model described in this paper. The feasibility of coaches using this process with fidelity in schools and other relevant settings, and also supports needed to scale-up implementation must be addressed. For example, how much time must be allocated for a coach to support teachers? How will this be integrated into other school initiatives and activities? What mentoring and support will coaches need? The interaction of these factors, including coaching implementation and fidelity and student and facilitator outcomes, must be further examined. Further, the necessity of each of the stages and actions defined in the SDLMI Coaching Model must be examined. Specifically, are there elements that are more and less feasible in practice? Second, attention must be directed to “understanding what sustains the implementation of evidence-based strategies in schools and how best to ensure effective interventions ultimately penetrate practice” (Carter et al., 2016, p. 230). As mentioned with regard to feasibility, the supports that are in place in a school or district for SDLMI implementation by facilitators and coaching using the SDLMI Coaching Model must be examined. Defining the supports that are most likely to influence outcomes and what components of the SDLMI Coaching Model are influenced by these supports must be also investigated. Only then, can the mechanisms that sustain SDLMI implementation be examined.

Third, it will be important to engage with coaches and facilitators to gather information on the SDLMI and its implementation. Each implementation of the SDLMI offers an opportunity to learn more about the practice
itself and the conditions under which it can be implemented with fidelity to achieve positive outcomes (Fixsen et al., 2005). Gathering facilitator and coaching feedback through regular surveys, interviews, and group meetings will be useful to define these issues. Future research should examine what aspects of the SDLMI Coaching Model and coach training make the largest impact on implementation fidelity. Examining the relationship between the level of fidelity, the optimal time for coaching, and coaching frequency will all be important future considerations. Further, exploring key characteristics that should be sought in SDLMI coaches that align with the SDLMI Coaching Model will be important. We need to identify what are essential characteristics and skills characterize effective SDLMI coaches and how those will be assessed over time. Fourth, Rush and Shelden (2011) emphasized the role of coaching training and self-reflection; therefore, it is imperative to develop a comprehensive training curriculum for coaches that provides initial training and ongoing supports throughout implementation. A key part of this ongoing support must be evaluation of the fidelity of the coaching process. The SDLMI Procedural Fidelity Checklist provides guidance on the steps that need to be taken by coaches; however, more work is needed to develop not only adherence measures but also quality measures, particularly aligned with the SDLMI Coaching Conversations. When a coach’s performance is consistently monitored in terms of their strengths and areas of improvement, the coaching process and methods can be adjusted and improved to better meet the needs of the facilitators.

Ultimately, the goal of the SDLMI Coaching Model is to provide supports that further enhance teaching practices that promote student outcomes. The goal of the SDLMI Coaching Model is to, in practice – particularly when scaling up the use of the SDLMI – to ensure that coaching leads to enhance teacher outcomes (e.g., change in the SDLMI knowledge, skills, and use related to self-determination instruction) which leads to enhanced student outcomes (e.g., self-determination, academic and transition goal attainment, progress in the general education curriculum). Future research of exploring the longitudinal impact of the SDLMI Coaching Model on teacher and student outcomes will refine the model and ultimately enhance the implementation fidelity of the SDLMI.

References


Building Early Numeracy through Virtual Manipulatives for Students with Intellectual Disability and Autism

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Abstract: Instructional technology is growing at rapid rates. In the field of mathematics, virtual manipulatives are a research-based tool that has shown to have a positive impact on students’ mathematic achievement, as well as student engagement in learning. In an effort to extend the research, this study investigated the impact of virtual manipulatives, when paired with research- (i.e., story-based math lessons) and evidence-based practices (i.e., systematic instruction, graphic organizers, manipulatives). This study used a single-case multiple probe across early numeracy math skills, with replication across student design. Two elementary students with autism and moderate intellectual disability used virtual manipulatives embedded within a story context to gain three early numeracy skills (i.e., set making, measurement, pattern making). Visual analysis of baseline, intervention, and maintenance phase data indicated a functional relationship between the use of virtual manipulatives and student math skills, and statistical analysis (Tau-U) further supported this with a large effect. Additionally, the virtual manipulatives were found to be more engaging than the tangible math manipulatives. Students were able to generalize and maintain the early numeracy skills across new math contexts. Implications and recommendations for practice and future research are provided.

In the most recent review of the literature on teaching mathematics to students with moderate and severe developmental disability, Spooner et al. (2018) examined research from 2005–2016. Spooner and colleagues found overall expectations for mathematics instruction has increased in hindsight of Browder et al.’s, 2008 analysis of the literature. While both the 2008 and 2018 reviews identified systematic instruction as an evidence-based practice, the most recent review identified additional practices as evidence-based. Specifically, Spooner et al. (2018) found explicit instruction, graphic organizers, instructional procedures of technology-aided instruction, and manipulatives to join the ranks as evidence-based practices to teaching mathematics to students with moderate and severe intellectual disabilities, including autism.

With increased expectations for students with severe disability, the findings of Spooner et al. (2018) begin to resemble research-based practice of the field of mathematics in general. Specifically, math instruction for students with severe disability has begun to bear a resemblance to that of learning disabilities (Gersten et al., 2009). Numerous studies have evaluated the effectiveness of manipulatives as a tool in building Concrete-Representational-Abstract (CRA) sequence (Gersten et al., 2009). Via explicit instruction, CRA moves students from concrete materials (manipulatives) to picture representations to abstract concepts. For example, Witzel et al., (2003) taught 34 matched pairs of middle school students with learning disabilities to solve algebraic equations using a traditional or CRA approach. While both groups of students showed improvement, the CRA group demonstrated significant growth. Manipulatives help students concretely represent abstract math concepts. Movement from concrete manipulatives to representational signify depth of understanding and application within the math context.

Over the past decade, instructional technology has grown at rapid rates (Docebo, 2016), with the research literature surrounding digital supports growing as well (eLearn Center,
In the field of mathematics, virtual manipulatives have become an increasingly common form of instructional technology utilized to support students with and without disability. Virtual manipulatives have been traditionally defined as “interactive, web-based visual representation of a dynamic object that presents opportunities for constructing mathematical knowledge” and are often designed to resemble concrete manipulatives (Moyer et al., 2002, p. 373). However, according to Moyer-Packenham and Bolyard (2016) an updated definition of virtual manipulatives was needed as “virtual manipulatives are presented on computer screens, on touch screens of all sizes (e.g., tablets, phones, white boards), as holographs, and via a variety of different viewing and manipulation devices.” (p. 4). Therefore, virtual manipulatives are “an interactive technology-enabled visual representation of a dynamic mathematical object, including all of the programmable features that allow it to be manipulated, that presents opportunities for constructing mathematical knowledge.” (p. 13). This revision implies that “a virtual manipulative may: (a) appear in many different technology-enabled environments; (b) be created in any programming language; and (c) be delivered by any technology-enabled device” (Moyer-Packenham & Bolyard, 2016, p. 4).

Virtual manipulatives have been shown to have a positive impact on students’ mathematics achievements, as well as student engagement in learning (Center for Technology Implementation, 2014). While limited, initial research on virtual manipulatives and students with severe disability has also demonstrated it to be an important tool to build math understanding within the classroom. For example, Bouck et al., (2014) explored the effectiveness of concrete and virtual (internet-based) manipulatives to teach three elementary students with autism spectrum disorder (ASD) to complete single- and double-digit subtraction problems. While both forms of manipulatives were successful, all three students gained independence and accurate responses at a quicker rate with the virtual manipulatives compared to the concrete manipulatives.

As instructional strategies in math education for students with severe disabilities further develops, it is important that future research not only apply and build upon the research- and evidence-base of mathematics education and learning disability fields, but attempts to combine them together into fluent cohesive curriculum. Typically, within the classroom, evidence-based practices are used together, not in isolation, to support effective instruction. Multi-component treatment packages have been shown as effective in supporting student math outcomes (Saunders et al., 2019; Spooner et al., 2018). When investigating evidence-based practice, it is often difficult to pull one practice (e.g., use of graphic organizers) without consideration of another (e.g., systematic instruction). Particular to this study, previous research has continually supported the notion of problem-based mathematics, conceptualized within meaningful scenarios, paired with systematic instruction (story-based lessons; Browder, Jimenez, & Trela, 2012; Browder et al., 2012). Specifically, Browder et al. (2012) used a multi-component treatment package that utilized story-based lessons, systematic instruction, graphic organizers, and manipulatives to teach early numeracy skills to students with severe disability.

Spoonner et al. (2018) found graphic organizers and manipulatives as two evidence-based practices that when used together can positively affect student outcomes. While the large majority of studies reviewed did utilize both graphic organizers and manipulatives (e.g., Jimenez & Staples, 2005; Root et al., 2017), only concrete representations were used. Virtual manipulatives were used in two studies (Bouck et al., 2014; Weng & Bouck, 2016); however, only Weng & Bouck (2016) paired the virtual manipulatives with the use of a graphic organizer (i.e., number line).

While not a component of the Spooner et al. (2018) review, previous research has found story-based math lessons useful in providing a meaningful context for math instruction (Browder et al., 2012). As currently available, generic virtual manipulatives are typically found via the internet (e.g., Illuminations, National Council of Teachers of Mathematics, (n.d.); National Library of Virtual Manipulatives [NLVM], n.d.) and do not lend themselves to unique and individually developed
theme based (linked to story context) math lessons. For example, Bouck et al. (2004) utilized the Base Ten Blocks via the NLVM to support subtraction skills of students with autism. Additionally, Weng and Bouck (2016) developed an app-based number line with counter dots to build number comparison skills for three students with moderate intellectual disability. While both of these studies support the use of virtual manipulatives for students with severe disabilities, additional research is needed to investigate the impact of virtual manipulatives, when paired with research-based (story-based math lessons) and other evidence-based practices (i.e., systematic instruction, graphic organizers).

Finally, within the key learning area of mathematics, early numeracy is a broad term used to refer to learned skills that involve explicit number knowledge, such as number identification, counting, patterns, comparisons, operations, and estimations (Root et al., 2018). Early numeracy is essential for advanced skill development and has been linked to future math performance (Jordan & Levine, 2009). A strong foundation in early numeracy for students with severe disability is necessary to acquire and generalize future mathematical learning (Saunders et al., 2019). With such a strong rationale for effective early numeracy instruction for this population of students, additional research is needed to extend and ‘combine’ the research in ways that utilize what we know to work, into a feasible multi-component package that is both effective for students and teachers.

The purpose of this study is to extend the research on the use of virtual manipulatives to support early numeracy instruction for students with intellectual disability. This study investigated the effect of a multi-component treatment package that included story-based virtual manipulatives, paired with graphic organizers and systematic instruction on three early numeracy skills (i.e., set making, measurement, pattern making) for students with severe intellectual disability, including autism. Research questions in the current study include the following: (a) what is the effect of a multi-component story-based virtual manipulative package on student acquisition of early numeracy skills? and (b) what is the effect of a multi-component story-based virtual manipulative package on student engagement during math lessons?

Method

Setting and Participants

This study was conducted in an elementary school in a rural school district in the southeastern United States. The school had three special education classrooms for students following extended content standards, in which both participants were placed. The classroom teacher had eight years teaching experience with students with ID. She was licensed in special education with a focus on high-incidence disabilities. The classroom teacher identified three students who would benefit from the intervention. Based on student records and professional judgement the teacher also selected students who had, (a) adequate visual discrimination to select objects and images; (b) adequate auditory discrimination to complete tasks named by the instructor; (c) motor ability to manipulate objects and a touch screen computer device (iPad); (d) identification of an intellectual disability or developmental delay; and (e) had not demonstrated mastery of set making, AB patterns, and measurement. Informed consent was obtained from all individual participants included in the study.

While all three students did begin the study, the third student was removed early into the intervention phase due to increased behavioral outbursts across all educational and community settings (e.g., biting, kicking, scratching). The particular outbursts were reinforced by attention and therefore it was decided by the educational team to remove her from the study. She did continue to receive math interventions from her classroom teacher, but no additional data were collected on her for this study.

Student participants. Geoff was an 8-year-old Hispanic male who received special education services under a diagnosis of autism. According to his most recent evaluation, Geoff had an IQ score falling in the extremely low range (TEMA - 3, Differential Ability Scales-II DAS 2). Geoff’s adaptive behavior fell into the ‘extremely low range.’ Geoff received speech and language services at least
once per week, and he also received ESL (English as a second language) services. Geoff often engaged in repetitive behavior, and while he was able to identify common objects and people verbally, most of his self-initiated verbal communication was self-talk and repetitive in nature (e.g., repeating lines from his favorite TV shows). Geoff was able to identify numerals and count to 10; however, he would often skip numbers or demonstrate low attention to the task. Geoff did display some signs of tactile defensiveness to some items in the math curriculum they were using (e.g., refuse to touch tangible manipulatives, such as rubber worms). Geoff would often get ‘lost in a task’ when counting (e.g., stacking materials by color, lining up manipulatives with extensive precision). Additionally, Geoff often found personal connections with educational materials that were unrelated to the performance task. For example, when presented with cars to count, he may think about a television show with a car and start to recite a script from an episode.

Callum was a 9-year-old Caucasian male who received special education services under a diagnosis of autism. According to his most recent evaluation, he had an IQ score that was declared as “unattainable” and his adaptive behavior fell into the low range, based on the Differential Ability Scales®-II DAS 2. Callum also received speech and language services at least once a week. Callum did not have any trouble using tangible manipulatives during math lesson; however, he was often unmotivated to participate in lessons. For example, he would often cry or put his head down during lessons, requesting his mother. Callum was able to perform some basic early numeracy skills, such as counting and numeral identification.

**Classroom setting.** All baseline and intervention sessions took place either within the students’ classroom or at a table located in the hallway outside of the students’ classroom. The classroom teacher acted as the primary interventionist of each math lesson. The second author, a university graduate student, served as the primary data collector. The table outside of the classroom was frequently used by teacher assistants or specialists for small group, resulting in the students being comfortable and acquainted with the environment. When utilizing the table in the hallway, only the students, interventionist and data collector were present. This space was only utilized when activities outside of their daily routine were taking place inside of the classroom. When within the classroom, all classroom students and instructors (one teacher and two teacher assistants) were present in their designated spaces (i.e., teacher assistant working with a small group of students, while the other teacher assistant was working one-on-one with another student, and teacher with math small group). Each lesson took place during the scheduled math session (30 minutes) at a table located in the back of the classroom, while other students completed their work in their small group. Each lesson was followed by an extrinsic motivational consequence (selecting an item out of a prize bag; i.e., a candy or small toy). This form of motivation was regularly practiced in the classroom prior to beginning the study, as well as being embedded into behavior plans created for both participants.

**Materials.** Each lesson was taught utilizing a portion of the materials from a story-based math curriculum, *Early Numeracy* curriculum (Jimenez et al., 2013). *Early Numeracy* is a scripted curriculum based on a conceptual model by Browder, Jimenez, et al. (2012) that outlines the use of research-based early numeracy skill trajectory (Sarema & Clements, 2009) and evidence-based practices for students with severe disability (Browder et al., 2008). Embedded instructional strategies of prompting, modeling, positive reinforcement, and manipulatives have been suggested to be effective in teaching mathematics skills to learners with autism (King et al., 2016; Spooner et al., 2018). *Early Numeracy* has been found to be effective in increasing the early number sense of students with autism who have co-morbid intellectual disability (Jimenez & Kemmery, 2013; Jimenez & Staples, 2005; Root et al., 2018); Saunders et al., in press, Wright et al., 2018). *Early Numeracy* focuses on number sense via a multi-component package that includes 3D theme-based manipulatives, graphic organizers, systematic instruction and story-based lessons across four units of instruction. For the purpose of this study, during the baseline phase, only specific components of the curriculum were used (i.e.,
During the intervention phase, select story-based lessons from Unit One were used from the curriculum along with systematic instruction (i.e., least to most prompting). However, during the intervention phase, graphic organizers and manipulatives were developed virtually through the use of the GoWorksheet Maker application (Attainment Company, 2015). See Figure 1 for more detail on the procedures used to develop the virtual manipulatives and Figure 2 for an example virtual manipulative and graphic organizer.

The iPad application (with virtual manipulatives and virtual graphic organizers), systematic instruction, and story-based lessons were utilized in both intervention and generalization phases across all three early numeracy skills. Both students were familiar with technology in the form of an iPad application, as they often used the iPad for educational games and e-books to support reading comprehension, phonics instruction, and number identification or money identification via common websites and apps.

**Dependent Variables and Data Collection**

Two dependent variables were measured in this study, early numeracy skill acquisition and student engagement. Both dependent variables were assessed in-vivo, during the actual math lessons taught by the teacher. The researchers assessed participant responses and engagement across baseline data, intervention, and generalization phases.

**Early numeracy skills.** The first dependent variable was students’ accuracy of completing the early numeracy skills embedded within the story-based math lesson: set making, non-standard measurement, and patterning. The three early numeracy skills were selected from the 12 skills taught in the Early Numeracy curriculum, as skills that required manipulatives to demonstrate understanding. For each skill students were provided manipulatives (3D during baseline data, virtual during intervention)
to demonstrate understanding. For set making, students were provided more manipulatives than needed, and asked to make a set of a given number (i.e., \( \geq 5 \)). For non-standard measurement, students were provided with an object associated with the story and asked to measure its length using manipulatives (e.g., paperclips). For patterning, students were provided materials associated with the story, the beginning of an ABA pattern, and asked to extend the pattern by identifying the next object. Five trials of each skill were embedded into each of the lessons, providing students a total of five opportunities to demonstrate an independent accurate response.

During baseline the instructor read the story-based lesson aloud, then presented the student with a question, graphic organizer, and objects to demonstrate the answer. For example, the facilitator read the story *Gardening with Grandpop*, presented the line counter graphic organizer from the *Early Numeracy* curriculum and seven rubber worm, then verbally asked the participants “Show me three.” Correct responses required participants to pick up or move the object(s) and move it to the graphic organizer within 5s of the task direction. Only independent correct responses were recorded as ‘correct.’ No prompting or feedback was given during the baseline phase.

Similarly, during intervention and generalization phases, the graphic organizer and manipulatives were virtually presented on the iPad. For example, the facilitator presents the iPad after reading a story about a class trip to Washington D.C., then verbally asked the participants “Show me 4.” Correct responses required participants to select the object(s) and move it to the graphic organizer within 5s of the task direction. During intervention lessons, in which no data were being recorded (every other lesson; 2–3 times per week), systematic instruction (least to most prompting system; Collins, 2012), was used for error corrections or if a student didn’t respond. During probe sessions, no prompting was provided. Only independent correct responses were recorded as ‘correct.’

**Engagement.** Engagement was defined as the appropriate use of manipulatives, tangible (during baseline phase) or virtual (during intervention, maintenance phases). A list of ‘inappropriate uses’ was developed for coding purposes, to track barriers to engagement prior to or during use of virtual manipulatives. The list of non-engaged behaviors noted were; engaging in touching/reaching for peer’s materials, mouthing, stacking or playing with objects, turning around in seat, elopement, reordering objects, or sorting objects. Both manipulative based ‘non-engaged behaviors’ (e.g., playing with objects) and general engagement behaviors (e.g., turning around in seat) were recorded during baseline and intervention to determine the effect of the virtual manipulatives on lesson engagement. No ‘other’ non-engaged behaviors were noted during baseline and/or intervention phases. As five
trials of each early numeracy skill was embedded into each of the math lessons, data were collected on each of these trials regarding student engagement. If a student was noted to be ‘non-engaged’ by exhibiting any of the seven behaviors during a learning trial, they were marked as ‘unengaged’ for that trial.

Data collection. For this study, the researchers measured the effect of the independent variable (i.e., multi-component story-based virtual manipulative package) on the dependent variables (i.e., number of correct early numeracy skill responses, number of trials engaged in math manipulatives). The researchers assessed participants based on their responses on a total of three math skills across baseline, intervention, and generalization sessions. Only independent, unprompted responses made during probe sessions were graphed, as well as engagement during each trial of the early numeracy task.

Probe sessions were conducted during the ongoing math lesson. Probes began with a general attention cue (i.e., “Are you ready?”). Following the attention cue, the facilitator (i.e., special education teacher) displayed the iPad and delivered the task (i.e., “Show me four.”). The researcher waited 5s for participant’s responses. If the participant picked up/moved the object(s) to demonstrate the correct response within 5s, the researcher recorded this as a correct response (i.e., “+”). If the student did not answer correctly, or the student did not make a response within 5s of the task direction, the researcher recorded this as an incorrect response (i.e., “−”). The preceding procedure continued for all five tasks within each of the three descriptors. Participants were not reinforced for any responses but were reinforced for participation using extrinsic motivation previously determined in classroom procedures and individual behavior plans.

Experimental Design

This study used a single case multiple probe across early numeracy skill design, with replication across students (Ledford & Gast, 2018). The implementation of the design adhered to the criteria established by the What Works Clearinghouse (WWC; Kratochwill et al., 2013). The primary dependent variable was accurate early numeracy skill performance. The secondary dependent variable was student engagement in math lessons and manipulatives. There were two experimental conditions of baseline and intervention, including maintenance probes. Both participants entered intervention when they had a minimum of five stable baseline data points on the primary dependent variable. When there was evidence of a positive effect of the intervention on the first early numeracy skill of set making for both students, a baseline probe was conducted on the other two early numeracy skills to assure no change in skill acquisition. Next, the second early numeracy skill of measurement was introduced virtually. Similar to the introduction of measurement skill trials, an additional baseline probe of the third early numeracy skill was conducted after a positive effect of the intervention on the second early numeracy skill was noted for both students. Systematic introduction to intervention continued for the third early numeracy skill of patterning. As recommended by Cooper et al., (2007), assessment of generalization was embedded in baseline and intervention through the use of various story-based lessons and virtual manipulatives.

Procedures

Baseline. During baseline, components included Early Numeracy stories from Unit One, graphic organizers, and 3D manipulatives for the three chosen math skills (i.e., set making, measurement, patterning). Although prescribed within the curriculum, no prompting procedures or error correction procedures were used. Rather the baseline probes were used to demonstrate student’s current accuracy of early numeracy skills and engagement with tangible manipulatives. Participants were only reinforced intermittently for participation through verbal praise and time to play with tangible manipulatives for fun.

During baseline, the lesson (story) was introduced by activating prior knowledge on the topic. For example, when reading about worms the facilitator would ask if the students have ever seen a worm and if they have gone fishing with worms before. After engaging students in the lesson, the story would be read aloud. Next, questions were asked based on
the teacher guide presented in the Early Numeracy curriculum. In order to ask the question, the graphic organizers and 3D objects (provided by the curriculum) were introduced to each student during the appropriate question (each student was familiar with the 3D objects and could identify its name). After introducing the object and organizer, the graphic organizer was placed in front of the student along with a variety of appropriate objects and then the student was presented the question orally. After the student had responded, the next student was asked the same question with an adjustment in the answer (show me three strawberries, show me two strawberries). Responses and engagement were recorded following each question. If the student did not provide an answer (moving objects to the designated area and then taking their hands away from the objects) within 5 seconds, the question was repeated. If the question was not addressed in an additional 5 seconds, objects were removed and coded as incorrect and the next question was presented to the next student.

Baseline responses were recorded based on student response to five trials of the early numeracy skill (i.e., set making, measurement, patterns) for a total of 15 questions per student, graphed separately by each skill. For example, the five questions regarding patterning were graphed separately than the five questions regarding set making. Additionally, student engagement was recorded for each question. Five consecutive baseline probe sessions were conducted and graphed for each participant. Verbal praise for working behaviors were given intermittently through baseline probes; however, no specific feedback was given for correct or incorrect answers. After baseline probes were complete, students were allowed to play with the materials used in the lesson (e.g., cars, plastic worms).

**Intervention.** The independent variable was the use of a multi-component package, that included systematic instruction on the use of a virtual manipulatives and virtual graphic organizers via an iPad application, aligned to the story-context within the Early Numeracy curriculum. During the intervention phase of this study, the same baseline procedures were used with the addition of presenting the students with an iPad and systematic instruction of the skills using 3D manipulatives). The iPad was received with the application installed containing a virtual graphic organizer and virtual manipulatives for the student’s responses. Similar to the baseline phase, one of the five different story options (context) from Unit One of the curriculum were randomly chosen. Additionally, the questions posed to students during the intervention phase during a lesson only pertained to the skill (e.g., patterning) being addressed in that session (five questions per skill per student).

Participants began the intervention phase with the early numeracy skill of set making, followed by measurement, then patterning progressively once they demonstrated a positive trend or level change from baseline. For example, while reading about a racecar lining up for a race, the facilitator was prompted via the curriculum teacher’s guide to ask the student to complete the pattern of the cars on the racetrack starting line. “Red, blue, red, blue . . . what comes next?” Each student was asked a variation of the same question. The student responded by dragging their chosen car to the answer indicator box within the iPad application. The recorder then identified whether the student was engaged and if their response was accurate.

The intervention was implemented every school day for approximately two months by the classroom teacher. While taught daily, data were collected every other lesson during the study period. Data were collected by the researchers. During each lesson a practice question (results not recorded) was provided by the teacher to ensure the student practice manipulating the application (touching and dragging the items to the correct location). During non-recorded lessons least-to-most prompting was utilized to teach the skills and application, as outlined in the Early Numeracy teacher’s manual (e.g., independent, verbal/model, physical). When an incorrect response was given, the facilitator gave a verbal prompt paired with modeling the correct response to demonstrate touching and dragging the items to the correct location. Then the facilitator asked the student to try again. If the student was still unsuccessful, the teacher would physically complete the task together with the student. If the student did not attempt to answer the question after 5 seconds, the question was
repeated. If the student still did not respond, following asking the question a second time, the teacher modeled the correct response and proceeded to the next student or question. However, during lessons in which data were collected (every other lesson; 2–3 times per week), restating the question was the highest level of prompting utilized.

Interobserver agreement. Interobserver agreement (IOA) was measured by a graduate student (second author) during the baseline phase and intervention phase of the study for each student response and compared using a point-by-point analysis. IOA was calculated by dividing the agreements by the total (agreements plus disagreements) and multiplying by 100.

IOA was taken on the first dependent variable (math skill) during 45% of baseline and 58% of intervention session with 100% agreement across all sessions for both students. For the second dependent variable (engagement), IOA was taken during 45% of baseline sessions with 97.4% agreement (range 87–100%) and 58% of intervention sessions with 100% agreement across all sessions for both students.

Procedural fidelity. Procedural fidelity was measured during the baseline phase and intervention phase of the study. The second researcher observed the special education teacher and recorded the presence or absence of teaching procedures during the delivery of the math lesson. Behaviors for fidelity of intervention sessions included (a) display graphic organizer, (b) story-based lesson, (c) objects/ virtual manipulatives, (d) delivery of question “Show 4,” including 5 second wait time, (e) repeating the question one time with wait time, if no response during first direction, (f) record student response, (g) record student engagement, (h) provide error correction if needed, and (i) praise and extrinsic motivation for participation. If all components of the trial were completed correctly, the trial was scored as occurring without error (±). If one or more of the components was completed incorrectly or omitted, the trial was scored as occurring with error (±). Procedural fidelity was calculated by dividing the number of trials presented without error by the total number of trials delivered total and multiplied by 100 (Billingsley, White, & Munson, 1980). Procedural fidelity was recorded for 45% of baseline sessions and 58% of intervention sessions with 100% adherence to the lesson protocol.

Results

Student Math Skills and Engagement

Figures 3 and 5 display the effect of the virtual manipulatives across three math skills reflected as the number trial correct. Both Geoff and Callum showed an increasing trend following the implementation of virtual manipulatives across each of the three math skills indicating a functional relation. Statistical analysis confirmed the presence of a large effect, Tau-U of .83 for Geoff and Tau-U of .85 for Callum. Additionally, student engagement is displayed on Figures 4 and 6 across each math skill. Statistical analysis confirmed the presence of a very large effect, Tau U of .99 for Geoff, and a large effect, Tau U of .66 for Callum (Vannest & Ninci, 2016).

Geoff. Overall, for the first dependent variable there was a change in level and/or trend across each of the three early numeracy math skills. For the second dependent variable, Geoff’s engagement with the math lessons during baseline (range 6–33; $M = 26$ non engaged behaviors) increased immediately (range 0–6; $M = .03$ non engaged behaviors) when using the virtual manipulatives across each of the math skills. There was a functional relationship between the use of virtual manipulatives and math skill achievement and student engagement in math lessons. Additionally, Geoff was able to generalize the math skills across multiple stories and virtual manipulatives.

Setmaking. During baseline, Geoff answered a mean of .2 setmaking math skill trials correct (range 0–1 trials correct). There was an immediate change in level of data once intervention occurred with a mean of 2.1 math skill questions correct out of 5 per session (range 0–3 trials correct). Maintenance data were taken two weeks after intervention ended and again two weeks later. Geoff maintained 3 out of 5 correct responses for both probes.
During baseline for the second dependent variable (engagement), Geoff was engaged in the set-making math lesson for a mean of 2 out of 5 trials per session (range 0–4). There was an immediate change in level and trend of data once the intervention occurred with 5 out of 5 trials engaged per session across all intervention and maintenance probe sessions.

Measurement. During baseline, Geoff answered a mean of .12 measurement math skill trials correct (range 0–1 trials correct). There was an immediate change in level of data once the intervention occurred with a mean of 3.4 trials correct out of 5 per session (range 1–5 trials correct). Maintenance data were taken two weeks after the intervention phase ended. Geoff maintained 3 out of 5 measurement skill trials correct.

During baseline for the second dependent variable (engagement), Geoff was engaged in the measurement math lesson for a mean of 1.8 out of 5 trials per session (range 0–3). There was an immediate change in level of data once the intervention occurred with a mean of 4.9 out of 5 trials engaged per session across both intervention and maintenance phases.

Patterns. During baseline, Geoff answered a mean of .1 patterning math skill trials correct (range 0–1 trials correct). After two in-
structional probe sessions, there was a change in level and trend of data with a mean of 2.6 trials correct out of 5 per session (range 0–5 trials correct). Due to the school holiday break, maintenance data were not taken on the final math skill.

During baseline for the second dependent variable (engagement), Geoff was engaged in the measurement math lesson for a mean of .8 out of 5 trials per session (range 0–2). There was an immediate change in level of data once the intervention occurred with 5 out of 5 trials engaged per session across all intervention data probes.

Overall, for the first dependent variable there was a change in level and trend across each of the three early numeracy math skills. For the second dependent variable, Callum’s engagement was already high, yet variable during baseline (range 0–7; M = 26 non engaged behaviors); however, once virtual manipulatives were introduced, his engagement and stability increased immediately (M = 0 non engaged behaviors). There was a functional relationship between the use of virtual manipulatives and math skill achievement and student engagement in math lessons. Additionally, Callum was able to generalize the

![Figure 4. Geoff’s engagement level during math lessons.](image-url)

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**Callum.** Overall, for the first dependent variable there was a change in level and trend across each of the three early numeracy math skills. For the second dependent variable, Callum’s engagement was already high, yet variable during baseline (range 0–7; M = 26 non engaged behaviors); however, once virtual manipulatives were introduced, his engagement and stability increased immediately (M = 0 non engaged behaviors). There was a functional relationship between the use of virtual manipulatives and math skill achievement and student engagement in math lessons. Additionally, Callum was able to generalize the

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math skills across multiple stories and virtual manipulatives.

Set-making. During baseline, Callum answered a mean of .8 set-making math skill trials correct (range 0–1 trials correct). There was an immediate change in level of data once intervention occurred with a mean of 3.4 math skill questions correct out of 5 per session (range 2–5 trials correct). Maintenance data were taken two weeks after intervention ended and again two weeks later. Callum maintained 4 out of 5 correct responses for the first probe and increased to 5 out of 5 correct for the final maintenance probe.

During baseline for the second dependent variable (engagement), Callum was engaged in the set-making math lesson for a mean of 4 out of 5 trials per session. There was an immediate change in level and trend of data once the intervention occurred with 5 out of 5 trials engaged per session across all intervention and maintenance probe sessions.

Measurement. During baseline, Callum answered a mean of .14 measurement math skill achievement.

Figure 5. Callum’s early numeracy and engagement responses (square = student engagement, diamond = math skill achievement).
trials correct (range 0–1 trials correct). There was an immediate change in level and trend of data once the intervention occurred with a mean of 2.6 trials correct out of 5 per session (range 1–4 trials correct). Maintenance data were taken two weeks after the intervention phase ended. Callum maintained 4 out of 5 measurement skill trials correct.

During baseline for the second dependent variable (engagement), Callum was engaged in the measurement math lesson for a mean of 3.4 out of 5 trials per session (range 0–5). There was an immediate change in stability and trend of data once the intervention occurred with 5 out of 5 trials engaged per session across all intervention and maintenance data probes.

Patterns. During baseline, Callum answered a mean of 1.8 patterning math skill trials correct (range 0–4 trials correct). There was an immediate change in trend of data once the intervention occurred with a mean of 3.5 trials correct out of 5 per session (range 1–5 trials correct). Due to the school holiday break, maintenance data were not taken on the final math skill.

Figure 6. Callum’s engagement level during math lessons.
During baseline for the second dependent variable (engagement), Callum was engaged in the patterning math lesson for a mean of 3.9 out of 5 trials per session (range 0–5). There was an immediate change in stability and trend of data once the intervention occurred with 5 out of 5 trials engaged per session across all intervention data probes.

Social Validity

At the conclusion of the study, the special education teacher completed a 7 question survey based on a 5-point Likert scale (5 strongly agree - 1 strongly disagree) regarding her belief that the use of virtual manipulatives was important for students with ID and ASD, the impact of the virtual manipulatives on student early numeracy and engagement, the appropriateness of the intervention procedure, and her likeness to continue to use the procedures and share with colleagues. The special education teacher responded with “5-Strongly Agree” for two questions, and “4-Agree” for five questions, demonstrating a strong social validity rating. Specifically, the teacher agreed that students with ID/ASD should be taught to use virtual manipulatives using systematic prompting procedure; however, she strongly agreed that instructional technology and early numeracy skill instruction was important for students with ID/ASD. Additionally, she agreed that the use of virtual manipulatives was easy, cost and time effective, and effective in meeting her student’s sensory, attention and educational needs.

Discussion

The purpose of this study was to evaluate the effectiveness of the use of a multi-component treatment package that included story-based virtual manipulatives, paired with graphic organizers and systematic instruction to increase early numeracy outcomes and student engagement. Visual analysis of the graphed data indicated both participants with ID and ASD demonstrated growth in early numeracy skills and were able to generalize skills across multiple math context (i.e., theme based virtual manipulatives linked with new stories). A Tau-U of .83 and .85 for the two students, confirms visual analysis of a large effect. Additionally, the use of virtual manipulatives increased student engagement across lessons and materials, as supported by visual analysis and a large effect size for both students as confirmed by Tau-U statistics.

Research has found that instruction via computers has significant positive impacts for students with autism spectrum disorder, and just as important students tend to prefer such interventions (e.g., Moore & Calvert, 2000; Shane & Albert, 2008). Similarly, in this study both students not only learned the early numeracy skills when instruction was delivered through virtual manipulatives, their engagement in the math lessons and materials increased.

Most recently, Bouck and Park (2018) conducted a literature review on the use of manipulatives in math education for students with disabilities. The authors make the clarification that while the use of ‘concrete’ manipulatives have been around for quite some time, many forms now exist, such as online and app-based ‘virtual’ manipulatives. It is noted that these virtual manipulatives most often resemble those that would be used within the classroom, such as Base Ten Blocks, tiles, fraction circles, and plastic/paper money. Bouck and Park (2018) found seven quality studies that utilized virtual manipulatives. Of these seven studies, all used manipulatives resembling ‘concrete’ tangible typically found within the classroom (e.g., Bouck et al., 2014; Base 10 Blocks). While Spooner et al.’s (2018) review of math evidence-based practice for students with moderate to severe intellectual disability also found manipulatives be an evidence-based practice, they only located one student who used virtual manipulatives. Therefore, this study adds to a much needed literature base on the usage of manipulatives, specifically virtual manipulatives for this population of students.

Linking the research base on the usage of manipulatives to support math learning to previous research-based practices in math education for students with moderate to severe intellectual disabilities is essential. Math stories ground real-life context in which mathematics facts and problems are demonstrated (Pugalee, 2004). A story-based approach to math lessons, such as those within the Early Numeracy curriculum, anchor each lesson (Browder, Jimenez, et al., 2012) providing students with an opportunity to immediately con-
nect knowledge, skill and application. This study also adds to the literature on story-based math instruction, by combining research and evidence based practice, through context-based virtual manipulatives, in a fashion that would resemble typical classroom instruction.

The most recent literature review on mathematics instruction for students with intellectual disability and autism identified five different ‘evidence-based’ and ‘research-based’ practices (e.g., systematic instruction, graphic organizers, manipulatives; Spooner et al., 2018). It is obligatory to conduct research that allows these practices to complement one another. Many teachers of students with intellectual disability and autism have identified barriers to manipulative based math instruction due to sensory input sensitivities, perseverative behaviors, and tactile definitiveness (Jimenez & Stanger, 2017). In addition, it is important to motivate students to become more engaged when using manipulatives in mathematics instruction in order to achieve the desired outcomes (Jones et al., 2011); virtual manipulatives as a means to reduce potential barriers for engagement may support student self-determination. By developing context-specific (story-theme related) virtual math manipulatives, we sought to respond to potential individualized student needs, while also ‘marrying’ together instructional practices (i.e., multi-component treatment package) that have continued to show positive student outcomes.

Limitations

In a literature review of technology-based interventions to teach academics to students with autism spectrum disorder, Knight et al., (2013) caution practitioners against blind usage of technology due to the limited quality research studies to validate academic gains for students. However, Knight et al. highlight the few studies that did meet rigorous research standards and their commonality of the use of systematic instruction. Knight and colleagues challenge researchers to respond to this review through high quality research practice, in order to support the potentially promising use of computer-assisted instruction (CAI). While we do believe that we have responded to their call for high quality research, there are a few limitations of the current study that should be highlighted and potentially addressed in future research.

Firstly, while each participant in this study does act as their own control across behaviors (i.e., math skills), this study was only conducted with two students within the same classroom. Both students were of similar age, both had autism and the math skills taught were identical. Generalization of the findings should be cautioned. Secondly, all materials for the units of instruction were developed by the research team. While the teacher did conduct the lessons, she was not expected to develop the virtual manipulatives and graphic organizers using the iPad application and curricular materials. Thus, this limitation should be considered in regards to feasibility, sustainability of implementation and the results of the social validity.

Implications for Practice and Future Research

More research is needed to investigate the usage of context-based virtual manipulatives within story-based math lessons using systematic instruction across other math skills, as only a limited number of skills were included in this study. Additionally, students of varying ages and disability (e.g., autism/intellectual vs. intellectual disability) should be included in future research to investigate the CAI, specifically context based manipulatives verses traditional virtual manipulatives, on levels of engagement.

Math instruction with the use of manipulatives and virtual manipulatives is not limited to special education. Although this study was conducted within a separate classroom for students with moderate to severe intellectual disability, practitioners and researchers should consider the use of virtual manipulatives, specifically context based, within the inclusive math classroom. Research on the use of embedded systematic instruction (Jimenez & Kamei, 2015) within on-going routines (e.g., math lesson) could be a great way to further investigate the use of a multi-component story-based virtual manipulative package in more inclusive contexts. Quality math instruction should be problem-based (Pugalee, 2004); consequently, the use of story-based math manipulatives (concrete or virtual) may prove to help bridge the CRA sequence, especially for those with disability. The use of systematic instruction has been shown to be effective in
increasing student’s academic gains within the inclusive classroom through embedded instruction (Jimenez & Kamei, 2015). Therefore, embedded trials of math skill instruction using virtual manipulatives and systematic instruction may be an effective way to provide additional support to students with moderate to severe intellectual disabilities within the inclusive math classroom.

While the teacher in this study did not make the virtual manipulatives for the study, we note that the GoWorksheet Maker application made the process fairly easy. Additionally, after setting up one set of materials with the graphic organizer, we were able to replicate the process with a new image (virtual manipulative) within seconds. Practitioners should plan how they and/or their teacher assistants can find time to make the materials. A benefit of virtual manipulatives for educators is that after the initial purchase of technology and in this situation the application, the images are uploaded into the application and teachers are able to access and store more manipulatives over time, rather than purchasing 3D concrete manipulatives for each story.

In conclusion, this study adds to the literature on the use of virtual manipulatives and systematic instruction to teach students with moderate to severe intellectual disability and autism. It offers a method to promote both research based (i.e., story-based math lessons) and evidence-based (i.e., manipulatives, graphic organizers, systematic instruction) practices in a student-responsive and easy to use fashion to promote an array of math skills. As the field of special and math education continue to identify new research based teaching methods, it is important to develop ways in which these practices can be used in combination to complement each other and to provide students engaging and effective instruction in mathematics.

References


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Learning Fractions with a Virtual Manipulative Based
Graduated Instructional Sequence

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Abstract: Fractions are foundational concepts for more advanced mathematics as well as used throughout daily living, for all students, including students with disabilities. This study explored the virtual-abstract (VA) instructional sequence with regard to the acquisition and maintenance of fraction behaviors for three middle school students with mild intellectual disability and/or autism. Through a multiple probe across participants design, students received a minimum of three sessions using the app-based manipulative (i.e., virtual portion of the VA instructional sequence) and a minimum of five sessions using numerical strategies (i.e., abstract portion of the VA instructional sequence). A functional relation was found between the independent variable—the VA instructional sequence—and the dependent variable (i.e., accuracy in finding equivalent fractions or adding fractions with unlike denominators, depending on the student).

Fractions are a challenging concept for students (National Mathematics Advisory Panel, 2008; Vukovic et al., 2014). One element of the challenge is that multiple meanings of the concept of fractions exist. Typically, fraction instruction begins with understanding fractions as part-whole (i.e., identifying that three shaded sections of a circle divided into five equal pieces is the fraction $\frac{3}{5}$), but then move into other conceptualizations, including measurement (e.g., number line, ruler), ratios, and division (Van de Walle et al., 2016). Additionally, multiple applications of fractions are subsumed under the domain of fractions, including identification, equivalence, and then applications (Fuchs et al., 2013; Jordan et al., 2013). Additional challenges with fractions can derive from, for example, an overgeneralization of knowledge of whole numbers (i.e., applying whole number strategies when working with operations with fractions; Namara & Shaughnessy, 2010; Van De Walle et al., 2016).

In addition to being complex, fractions are foundational for more advanced mathematics as well as used throughout daily living (Bailey et al., 2012). In a study examining adult use of mathematics in their daily lives, individuals in the researcher-ascribed normal use of mathematics group reported using fractions at least once a month (Duchhardt et al., 2017). Fractions are present throughout different facets of adult or everyday life, with a notable example being baking or cooking (Bartholomew et al., 2015). Hence, an understanding of different fraction problems (e.g., fractional parts, equivalent fractions, operations with fractions; Van De Walle et al., 2016) is important for all students, including students with disabilities.

Research on Fractions and Students with Disabilities

For students with disabilities, research on fractions exists but is ripe for further development, particularly for students with disabilities other than learning disabilities. Shin and Bryant (2015), in their review of fraction interventions for students with more high-incidence disabilities, found 17 studies. The majority of the studies were focused on secondary students and such content included adding or subtracting fractions with like or unlike denominators, equivalent fractions, and multiplying fractions by whole numbers.
Common instructional approaches in the review by Shin and Bryant (2015) included representations—concrete and visual (e.g., the concrete-representational-abstract instructional sequence), explicit instruction, and/or heuristic strategies. For students with mild intellectual disability, from the most recent review of academic mathematical interventions, zero studies focused on fractions (Hord & Bouck, 2012). Similarly, in the recent published reviews of mathematical interventions for students with more moderate or severe disabilities, limited attention was found for fractions (Barnett & Cleary, 2015; King et al., 2016; Spooner et al., 2018). King et al. (2016), in their review of mathematics interventions for students with autism, found zero studies addressing fractions. This was also true for the review of mathematical interventions for students with autism conducted by Barnett and Cleary (2015). Likewise, Spooner et al. (2018) found no studies conducted regarding fractions for students with moderate and severe developmental disabilities.

More recently, different research teams conducted a few studies involving fractions and students with autism and/or mild intellectual disability (Bouck, Bassette, et al., 2017; Bouck, Park, et al., 2017; Bouck, Shurr, et al., 2018; Gevarter et al., 2016; Yakubova et al., 2015). Across the four studies, researchers examined graduated sequences of instruction and/or manipulatives to some degree. Yakubova and colleagues (2015) taught three high school students with autism, via the concrete-representational-abstract (CRA) instructional sequence in conjunction with video modeling, to solve word problems involving the subtraction of fractions. The CRA is an instructional sequence in which students transition from solving mathematical problems with concrete manipulatives to solving such problems with drawings (i.e., representations), and finally to solve mathematical problems abstractly with numerical strategies (Agrawal & Morin, 2016). Bouck, Park, et al. (2017) and Bouck, Bassette, et al. (2017) examined the virtual-abstract (VA) and virtual-representational-abstract (VRA) instructional sequences, respectively, to teach students with disabilities—including students with mild intellectual disability—to find equivalent fractions or add fractions with unlike denominators, respectively. The VRA is an adaptation from the CRA; students are first taught to solve problems with a virtual manipulative, then a drawing, and finally with a numerical strategy. The VA is a modification to the VRA, in which the representational (i.e., drawing) phase is not introduced (Bouck & Sprick, 2018). In all these of these studies, a functional relation existed between the intervention and acquisition of solving the fraction problems in question. The last study, Bouck, Shurr, et al. (2018) compared the efficacy of concrete and virtual manipulatives to support students with mild intellectual disability and learning disabilities to add fractions with unlike denominators. Both types of manipulatives were effective.

As noted, fractions are an important mathematical domain for both advanced academic mathematics as well as daily living (i.e., independent life) skills. Yet, limited research exists regarding the efficacy of interventions to teach fractions to students with autism and/or mild intellectual disability. The current study sought to extend the exploration of the use of the VA instructional sequence to support three middle school students with disabilities in learning to solve fractions problems (i.e., finding equivalent fractions or adding fractions with unlike denominators). This study builds upon a previous study exploring the VA instructional sequence to teach fractions to students with disabilities (Bouck, Park, et al., 2017). Like the study by Bouck, Park, et al. (2017), this study removed the representational (i.e., drawing) phase consistently found in the research involving graduated sequences of mathematics instruction (e.g., the CRA or VRA); Bouck, Bassette, et al. (2017) found drawing fractions challenging and frustrating to students with similar disabilities. However, this study extended the work by Bouck, Park, et al. (2017) by increasing the number of mastery sessions for the abstract phase of the sequence with the goal to improve maintenance (i.e., performance not proceeded by instruction; Alberto & Troutman, 2009); in the study by Bouck, Park, et al. (2017), all students experienced decreasing trends in maintenance. The research questions for the study were (a) to what extent can students learn to solve fraction problems when provided instruction with the VA instructional sequence; (b) to what extent do students main-
tain their ability to solve fraction problems after receiving instruction via the VA instructional sequence; and (c) what are students’ perceptions of the VA instructional sequence?

Method

Participants

Two of the three participants (i.e., Natalie and Jo) were educated in the same special education mathematics classroom within a mild cognitive impairment program (the state referred to the disability as cognitive impairment; elsewhere it is referred to as intellectual disability). The third participant Blair received mathematics education within the same mild cognitive impairment program during a different class period. All three participants were educated by the same certified special education teacher. The state in which the study occurred licensed teachers according to a particular disability category (e.g., learning disability, cognitive impairment), which explains the program classification. However, students with other disabilities than the program name could be educated there; the classroom functioned as a self-contained classroom providing alternative content area instruction to qualifying students. All three participants had participated in a previous study involving mathematics and manipulatives and/or graduated sequences of instructions, but for different mathematical behaviors.

Blair. Blair was 14 at the time of the study and enrolled in the eighth grade; she was a white female. According to her Individual Education Program (IEP), Blair was provided services under the category of intellectual disability; the most recent IQ from the Wechsler Intelligence Scale for Children—Fourth Edition (WISC-IV; Wechsler, 2004) was 53. Also, according to her IEP, Blair was to receive services in the mild cognitive impairment program for 10 hours per week, which consisted of her mathematics and language arts courses. Her researcher-administered KeyMath-3 (Connolly, 2007) numeration score was 20, which was a 4.1 grade equivalency; her total operations score (36) represented a 3.4 grade equivalency. On a fraction pre-assessment administered by researchers, Blair demonstrated she could identify and find equivalent fractions at 100% but could not add fractions with unlike denominators.

Natalie. Natalie was a 13-year-old, sixth-grade, white female. Natalie received special education services under the category of autism, although her file did not contain any assessment scores related to IQ, achievement, or autism screenings. According to her IEP, Natalie was to receive 10–15 hours of services per week in middle school mild cognitively impaired program, including her mathematics instruction. Also, on her IEP, Natalie was to participate in the state accountability system through the general large-scale assessment with accommodations. On the KeyMath3 (Connolly, 2007) administered by researchers, Natalie’s total numeration score was 13, which represented a 2.0 grade equivalency, and her total operations score (13) represented a 1.6 grade equivalency. On the researcher-administered fraction pre-assessment, Natalie could identify fractions but could not determine equivalent fractions.

Jo. Jo was a 12-year-old, white female, who received special education under the category of Otherwise Health Impaired. Specifically, Jo was identified as having Chromosome 3Q29 microduplication syndrome, which manifested itself as Jo demonstrating behavior or characteristics similar to pervasive developmental disorder and ADHD. Her scores on autism screenings indicated Jo did not meet the criteria for autism. On the Wechsler Intelligence Scale for Children—Fourth Edition (WISC-IV; Wechsler, 2004), Jo’s full-scale IQ was 70. She was in sixth grade and receiving services in middle school for the first year. According to her IEP, Jo received educational services in a secondary mild cognitive impairment program for 15–25 hours per week, including her mathematics class. Jo was to participate in the state’s accountability system through an alternate assessment. Jo received a numeration score of 13 on the researcher-administered KeyMath-3 (Connolly, 2007), which indicates a grade equivalency of 2.0; her total operations score was 24 (i.e., 2.6 grade equivalency). Like Natalie, Jo could identify fractions but could not find equivalent fractions on the researcher-administered fraction pre-assessment.
Setting

The setting for the study was the public middle school in a rural Midwestern town. The student enrollment was 452 across grades 6, 7, and 8. Approximately one-fourth of the student body (26.7%) received free and reduced lunch. Ten percent of the students were identified as students with an IEP. The majority of students in the school were white (95%). Other student ethnicities included Latino/a (3%), and two or more races (2%). The actual study itself occurred in a hallway in the middle school. Specifically, researchers worked one-on-one with students at tables outside of the students’ special education classroom. Researchers worked with students during their time in the special education setting; all class periods were 61 minutes in length and study activities generally took about 15–30 minutes per session, with the majority closer to 20.

Materials

The materials for this study were mathematics (i.e., fractions) learning sheets and an iPad2 with a fraction manipulative app installed. During the virtual phase of the VA instructional sequence the Fraction Manipulatives app by Brainingcamp (2018) was used on an iPad. On the app, fraction tiles are provided on the left side, and each fraction (i.e., \(1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}, \frac{1}{8}, \frac{1}{10}, \frac{1}{12}\)) is depicted with a different color. The app includes a white screen in which the fraction tiles can be manipulated as well as colored markers to write on the white screen.

Each learning sheet consisted of one or two pieces of printed (i.e., 8.5 × 11 inch) paper. During intervention, each learning sheet was compromised of two problems for researcher modeling on the first page; two problems for guided instruction printed on the reverse; and, on the last page, five problems for students to solve independently. During baseline and maintenance, each learning sheet consisted only of the five problems to solve independently. The problems on each learning sheet involved adding fractions with unlike denominators or equivalent fractions, depending on the participant (i.e., Blair added fractions with unlike denominators [e.g., \(\frac{2}{3} + \frac{2}{12}\)] and Natalie and Jo found equivalent fractions [e.g., \(\frac{2}{3} = /12\)]. The fractions selected for the problems—equivalent or addition with unlike denominators—were based on availability within the fraction manipulative app (i.e.,1, \(1/2, 1/3, 1/4, 1/5, 1/6, 1/8, 1/10, 1/12\)); researchers produced problems based on all the numerical possibilities with the app fraction tiles. Researchers then randomly assigned the problems to the learning sheets, while keeping track to keep each learning sheet unique. Each problem was used once.

Independent and Dependent Variables

The independent variable for the current study was the VA instructional sequence. The VA instructional sequence consisted of two phases: virtual and abstract (Bouck, Park, et al., 2017). The dependent variable was students’ accuracy for finding equivalent fractions or adding fractions with unlike denominators, depending on the mathematical behavior the student was working on, during the independent portion of each session. Accuracy was represented as a percentage out of the five possible problems. Event recording was used to capture accuracy.

Experimental Design

To design and implement the study, the researchers used the quality indicators and standards for single case research by the Council for Exceptional Children (2014). In order to determine if a functional relation existed between VA instructional sequence and student acquisition of solving fraction problems (i.e., finding equivalent fractions or adding fractions with unlike denominators), a multiple probe across participants design was used. Per the design, the baseline phase began simultaneously for each participant. After a minimum of three baseline sessions, which were to be stable (i.e., 80% of the data fell within 25% of the median [Gast & Spriggs, 2014]) with a zero-celerating or decelerating trend, the first student entered the virtual portion of the VA intervention. Once the first student achieved the pre-determined mastery criteria (80% accuracy for three sessions for the virtual phase),
she entered the abstract portion of the VA intervention. At this time, the second student completed one additional baseline and, if the baseline data were stable with a non-accelerating trend, she entered the virtual portion of the VA intervention. The phases continued as such until all three participants progressed through the VA instructional sequence and reached mastery criteria for both the virtual and abstract portions of the VA instructional sequence. For the abstract portion, mastery was set at student accuracy of a minimum of 80 for five sessions. If a student scored less than 80% on any intervention session—virtual or abstract—the lesson was repeated. Two weeks after mastery of the abstract phase, each participant completed two maintenance sessions.

Procedure

Three members of the research team delivered the intervention. All three interventionists worked with all three students in the study; no one interventionist worked with just one student. Two of the interventionists were special education doctoral students, and both were trained by the first author—a special education faculty member with more than a decade of experience exploring mathematical interventions and students with disabilities or at-risk of a disability. The two other interventionists role-played an intervention session with the first author prior to the delivery of the intervention and demonstrated proficiency before implementation. Sessions generally occurred two days a week—one if there was no school due to weather or a planned day off—for 13 weeks and each occurred for no more than 30 minutes during the 61-minute math class period. Students typically received one or two sessions per day, although for the most part one session was provided per day. The session schedule was determined based on the availability of the teacher and students. During the study, no participant received any instruction via the VA instructional sequence to learn fractions or any other math skill outside of study activities. No participant also received any other type of fraction instruction during the study.

Baseline. Baseline for each participant occurred for a minimum of three sessions. During each baseline session, students were given an 8.5 × 11-inch piece of paper with five fraction problems—either finding equivalent fractions or adding fractions with unlike denominators, dependent on the participant. Students were asked to solve the problems; the students were to correctly add the fractions or provide the equivalent fraction, depending on the student. Researchers provided students with no prompts or supports during baseline sessions.

Intervention. The intervention was the VA instructional sequence. Using the VA instructional sequence there were, at minimum, three sessions in which the students used the virtual manipulative (i.e., the app Fraction Tiles by Brainingcamp, 2018) to learn to add fractions with unlike denominators or determine equivalent fractions, dependent on the participant. There was also, at minimum, five sessions in which the students used only numerical strategies to solve the problems (i.e., abstract phase). To move from the virtual to the abstract phase, the student needed to answer 80% of the problems correctly for three sessions during the independent portion of the intervention. If a student did not achieve 80% accuracy during the independent portion of the learning sheet, she repeated the same lesson the next session. To complete the abstract phase, the student needed to achieve at least 80% accuracy for five sessions.

For each intervention session, regardless of virtual or abstract, the researcher provided explicit instruction. During each intervention session, the researcher modeled two problems and, depending on the phase (i.e., virtual or abstract) used either the virtual manipulative or numerical strategies. While the researcher modeled the first two problems she provided a think-aloud method, meaning the researcher provided a verbal description for her mathematical thought processes (e.g., how and why; Agrawal & Mortin, 2016). Next, during the guided portion of explicit instruction, the researcher provided prompts and cues, as needed, and the student independently solved two problems. Finally, the student solved five problems independently with either the app or numerical strategies depending on the intervention phase (i.e., virtual or abstract). Note, if a student could not complete the majority of steps during the guided phase
and/or needed prompting for each step to solve a problem during the guiding portion, the researcher modeled another problem. If the students could not work through the guided portion without being prompted at every step after modeling two additional problems, the researcher would not allow the student to move into the independent portion of the learning sheet and discontinued the session. The researcher would model a maximum of four problems and provide prompts and cues on a maximum of four problems before discontinuing the session.

Virtual phase. The first three intervention sessions consisted of students using the virtual manipulative app (i.e., Fraction Tiles by Brainingcamp, 2018). During each virtual session, the researcher modeled solving two problems using the app (see Table 1 for detailed description of the modeling and think aloud for each of the fraction problems for both the virtual phase and Figure 1 for a screenshot of the app for both fraction problems). The modeling involved a physical demonstration, while providing a verbal narration (i.e., a think aloud). Then, the researcher supported students in the guided portion, providing prompts or cues as needed while the student worked to solve two problems on their own. Examples of prompts included, “remember to find the common denominator” or “remember, if you multiply the denominator by 2, you need to multiply the numerator by the same number.” Finally, the student independently solved five problems with the aid of the virtual manipulative.

Abstract phase. The abstract intervention sessions consisted of using solely numerical reasoning and/or strategies to solve the problems. The researcher modeled how to solve the problems, utilizing only the think-aloud method (i.e., verbal narration), pencil, and paper (see Table 2 for detailed description of the modeling and think aloud for each of the fraction problems for both the virtual phase). Similar to the virtual phase, the researcher modeled two problems. In the guided portion of explicit instruction, the researcher provided prompts or cues as needed, while the student worked to solve two problems on their own. Examples of a prompt could be, “remember, we add the numerators” or “you can use the calculator to find the factor.” Finally, the student independently solved five problems using only numerical strategies.

Maintenance. Two weeks after each student achieved the abstract phase mastery criteria (i.e., five sessions with a minimum of 80% accuracy), she partook in two maintenance sessions. For each maintenance session, the student was provided with five fraction problems of their respective type—equivalent fractions or adding fractions with unlike denominators. Procedures were similar to baseline; students did not have access to the app, feedback, or any prompts.

Interobserver Agreement and Treatment Fidelity

Inter-observer agreement data (IOA) were collected and assessed for at least 33.3% of sessions per baseline, intervention (i.e., both virtual and abstract portions), and maintenance phases. IOA was calculated by determining the number of agreements for the accuracy of answers and then dividing by the sum of the total number of agreements and disagreements. The IOA is 100% across all students across all phases. Researchers also evaluated the intervention phase for treatment fidelity. A treatment fidelity checklist was implemented for a minimum of one-third of intervention sessions for each virtual and abstract portion of the intervention sessions. Treatment fidelity was 100% for all sessions assessed for each student.

Social Validity

Each student was asked four social validity questions at the end of the study. They were asked if they liked learning about fractions and why, if they liked using the app or just the numerical strategies better to solve the fraction problems and why, what they would like to use in the future, and if they wanted to say anything else. The social validity interviews occurred one-on-one between the student and a member of the research team. The social validity interviews occurred after the last maintenance session was complete.

Data Analysis

Researchers used visual analysis to analyze the student data. The researchers analyzed the
TABLE 1
Examples of Modeling Portion of Explicit Instruction in the Virtual VA Phase

<table>
<thead>
<tr>
<th>Virtual: Adding Fractions with Unlike Denominators</th>
<th>Virtual: Finding Equivalent Fractions</th>
</tr>
</thead>
<tbody>
<tr>
<td>The researcher began the modeling phase by bringing the 1 whole fraction tile onto the working white space. Then the researcher set up the problem (e.g., $\frac{2}{3} + \frac{2}{12}$), reminding students that the denominator represents how many equal parts a whole is broken into (e.g., 3 and 12) and the numerator tells how many of those parts you want (e.g., 2 and 2). The researcher dragged out two one-third fraction tiles placing them next to each other and immediately under the one whole. Next, the researcher dragged out two one-twelfth fraction tiles, placing them directly next to the two one-thirds pieces under the 1 whole. The researcher explained to the participant that when adding fractions, the denominators need to be the same and, because 3 and 12 are not the same, a common denominator was needed. The researcher then discussed that sometimes the common denominator is one of the fractions, meaning one of them (e.g., 3) is a factor of the other (e.g., 12). If one denominator is a multiple of the other (e.g., 12), then the next step is to determine the equivalent twelfths fraction for $\frac{2}{3}$. Dragging out $\frac{1}{12}$ tiles and putting them underneath the $\frac{2}{3}$ until they were equal represented a means of determining equivalent fractions (e.g., $\frac{8}{12}$). The researcher also stated that this was like asking for the relationship between 3 and 12 and determining that $3 \times 4 = 12$. The researcher reminded the student that when finding equivalent fractions, what one does to the denominator one must also do to the numerator. So, if one multiplies the denominator 3 by 4 to make an equivalent twelfths fraction, one must also multiply the numerator by 4 (e.g., $2 \times 4 = 8$). The problem now read: $\frac{8}{12} + \frac{2}{12}$. The researcher reminded the students the denominators need to be the same to add fractions. The researcher counted up the number of twelfths, which was 10 (i.e., $\frac{10}{12}$), and reminded the student that when adding fractions, one adds the numerators of fractions with the same denominator.</td>
<td>For example, with the problem $\frac{1}{3} = \frac{\boxed{4}}{12}$, the researcher began by accessing a student’s background knowledge relative to fractions (i.e., what the denominator and numerator mean). Then the researcher set up the problem on the app. First, the researcher dragged out the 1 whole tile and then placed one one-third tile immediately underneath. Next, the researcher indicated she wanted to determine how many one-twelfths was equal to $\frac{1}{3}$ and dragged $\frac{1}{12}$ tiles directly underneath the $\frac{1}{3}$ until they were evenly aligned, which was 4. The researcher reinforced that to check one’s work one would look mathematically at how to find equivalent fractions. The researcher discussed determining the relationship between 3 and 12, in other words, what can one multiply 3 by to get 12 as a product. In this case, the factor is 4 and reinforced that in solving equivalent fractions, what one does to the denominator, one must also do to the numerator. Hence, $\frac{1}{3} \times \frac{4}{12}$.</td>
</tr>
</tbody>
</table>
data for level, trend, immediacy of effect, and effect size. To determine level, researchers applied the 80-25 rule, which suggests if 80% of the data falls within a 25% range of the median the data are stable (Gast & Spriggs, 2014). Otherwise the data are variable. To determine trend, researchers applied the split-middle technique (White & Haring, 1980). The split-middle technique involved finding the middle point of the data for each phase (e.g., base-

![Figure 1. Fraction Tile App by Brainingcamp (2018) for both Types of Fraction Problems](image)

**TABLE 2**

**Examples of Modeling Portion of Explicit Instruction in the Abstract VA Phase**

<table>
<thead>
<tr>
<th>Abstract: Adding Fractions with Unlike Denominators</th>
<th>Abstract: Finding Equivalent Fractions</th>
</tr>
</thead>
<tbody>
<tr>
<td>With the problem ( \frac{1}{5} + \frac{7}{10} ), the researcher began by discussing the need to have the denominators be the same and hence needing to find equivalent fractions. The researcher discussed that 5 is a factor of 10, so 10 is a common denominator of the two fractions and modeled how to solve what 5 is multiplied by to get 10. This was done by the researcher verbalizing that ( 5 \times 2 = 10 ), going through the 5s multiplication facts ( (5 \times 1 = 5; 5 \times 2 = 10) ), and finally by illustrating how to use a calculator (i.e., one way to solve what one multiples by 5 to get 10 is by dividing 10 by 5; ( 10 \div 5 = 2 ) so ( 5 \times 2 = 10 )). The researcher then stated that what one does to the denominator one must do to the numerator when finding equivalent fractions. Hence, ( 1 \times 2 = 2 ), so the equivalent fraction is ( \frac{2}{10} ) and the new equation is ( \frac{2}{10} + \frac{7}{10} ). Then the researcher modeled that in solving addition of fraction problems, one adds the numerators and the denominator remains the same, so the answer would be ( \frac{9}{10} ).</td>
<td>With the problem ( \frac{2}{4} = \frac{4}{8} ), the researcher began by reminding students the language of fractions (i.e., denominator and numerator) and discussing what was meant by equivalent fraction (i.e., have the same value). The researcher discussed seeing the relationship between the denominators, in other words, is one denominator a factor or multiple of the other denominator. In the example ( \frac{2}{4} = \frac{4}{8} ), the researcher verbalized 4 is a factor of 8, meaning 4 multiplied by another number equals 8. The researcher demonstrated techniques to determine the factor, including knowing ( 4 \times 2 = 8 ), going through the 4s multiplication fact families (i.e., ( 4 \times 1 = 4, 4 \times 2 = 8 )), and using a calculator to find the relationship between 4 and 8 by dividing 8 by 4. The researcher then reminded students that with equivalent fractions what one does to the denominator, one must also do to the numerator, so if the denominator is multiplied by 2 so must the numerator. The equivalent fraction is then ( \frac{4}{8} ).</td>
</tr>
</tbody>
</table>
line) and subsequently the mid-rate and mid-date. A line was then drawn between the mid-rate and mid-date and analyzed to determine if the line is accelerating, decelerating, or zero-celerating. Researchers determined the immediacy of effect by analyzing the last baseline session and the first intervention session and visually inspecting if the change between phases was gradual or immediate. Finally, researchers calculated Tau-\(U\) as a measure of effect size. Researchers used an online calculator (see http://www.singlecaseresearch.org/calculators/tau-u), to determine the Tau-\(U\) between baseline and intervention (virtual plus abstract) for each student and applied the metrics regarding the size of the effect (i.e., above 92% large, less than 66% small, and between a medium; Parker et al., 2009; Parker et al., 2011).

**Results**

Overall, a functional relation was found between the intervention—the VA instructional sequence—and the dependent variable (i.e., finding equivalent fractions or adding fractions with unlike denominators; see Figure 2 and Table 3). Two of the three students needed zero sessions repeated and maintained at levels consistent with their intervention performance. One student (i.e., Jo) struggled significantly during the abstract portion, in which students used numerical strategies only without the aid of the app-based manipulative solve the fraction problems.

**Blair.** Blair, who was learning to add fractions with unlike denominators, had low levels of accuracy during baseline. Her baseline data reflected a zero-celeration trend. Across the three baseline sessions, she answered only one problem correctly (see Figure 2 and Table 3). Upon entering intervention (the virtual portion of the VA instructional sequence), Blair experienced an immediate effect (100% accuracy). Blair maintained 80–100% accuracy throughout all eight of the intervention sessions; Blair repeated zero intervention lessons. Blair’s intervention data had an accelerating trend, and she ended her last three intervention sessions achieving 100% accuracy. The Tau-\(U\) between Blair’s baseline and intervention data was 100%. Blair maintained similar rates when no explicit instructional sequence and/or manipulatives were provided. During maintenance, Blair’s accuracy was 100% and 80%.

**Natalie.** Natalie answered zero equivalent fraction problems correctly during her four baseline sessions; her baseline data reflected a zero-celeration trend (see Figure 2 and Table 3). Natalie experienced an immediate effect with her first intervention session (100% accuracy). Natalie maintained 100% accuracy for all but one of her eight intervention sessions; she repeated zero lessons. Natalie’s intervention data had a zero-celeration trend and were stable. The Tau-\(U\) between Natalie’s baseline and intervention data was 100%. Natalie was also able to maintain her accuracy when explicit instruction was not provided prior to independent practice and no app-based manipulative was provided (100% and 80% accuracy).

**Jo.** Jo’s baseline data were low; she answered zero questions correctly for four of the five sessions (see Figure 2 and Table 3), reflecting a zero-celeration trend. With her first virtual session of the intervention (VA instructional sequence), Jo experienced an immediate effect (100% accuracy) and maintained 100% accuracy throughout all three of the virtual sessions. Jo, however, greatly struggled with the abstract portion of the intervention. Throughout the first four presentations of the first abstract lesson, Jo did not advance to the independent phase of explicit instruction because she did not display understanding and the ability to attempt problems on her own. After modeling two problems, Jo could not perform any aspects of solving the equivalent fractions problems independently during the guided phase; the researchers essentially modeled two problems during the guided phase. The researchers allowed Jo to try two more guided problems, but she was unsuccessful in independently even attempting to find a common denominator as well as displayed signs of frustration (e.g., getting teary-eyed, talking louder), so researchers discontinued the sessions. On the fifth attempt, Jo was able to engage in the two guided problems; she was 20% accurate during the independent phase of this session. After repeating the first abstract lesson in which she actually attempted the independent phase twice, Jo scored 100% accuracy and maintained 100% accuracy for
Figure 2. Graphed Data of Each Participant's Accuracy across Phases of the Study
Note: * indicates a session was conducted but the student did not advance to the independent portion from the guided. Ψ indicates the first virtual session.
three sessions. She also had to repeat lessons 4 and 5 (both initially 60% accuracy) once. Jo’s maintenance scores were above baseline and consistent with some of her accuracy scores during the abstract portion of the intervention (80% and 60%).

### Social Validity

All three of the students were excited to learn more about fractions and to use the app. All three students had prior exposure to different math apps (i.e., an algebra tiles app and a fraction circles app for the purpose of teaching to identify fractions). All three stated they enjoyed using the app more than solving problems without the app and wanted to use an app in the future. They felt the app helped them to solve the mathematics and provided additional support as they worked through the problems. Each of the students looked forward to working with the researchers one-on-one and, generally, asked to use the app each session.

### TABLE 3

Data Analysis Summary of the VA Instructional Sequence Across Participants

<table>
<thead>
<tr>
<th>Measure</th>
<th>Baseline</th>
<th>Overall Intervention</th>
<th>Virtual</th>
<th>Abstract</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blair</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>0</td>
<td>80%–100%</td>
<td>80%–100%</td>
<td>80%–100%</td>
<td>80%–100%</td>
</tr>
<tr>
<td>Mean</td>
<td>0</td>
<td>87.5%</td>
<td>86.7%</td>
<td>88%</td>
<td>90%</td>
</tr>
<tr>
<td>Median</td>
<td>0</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>90%</td>
</tr>
<tr>
<td>Stability</td>
<td>S</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>S</td>
</tr>
<tr>
<td>Trend</td>
<td>Z</td>
<td>A</td>
<td>D</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>Tau-U*</td>
<td>—</td>
<td>100%</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>PND</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td># of sessions</td>
<td>3</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td># lessons repeated</td>
<td>—</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>Natalie</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>0</td>
<td>80%–100%</td>
<td>100%</td>
<td>80%–100%</td>
<td>80%–100%</td>
</tr>
<tr>
<td>Mean</td>
<td>0</td>
<td>97.5%</td>
<td>100%</td>
<td>96%</td>
<td>90%</td>
</tr>
<tr>
<td>Median</td>
<td>0</td>
<td>100%</td>
<td>100%</td>
<td>80%</td>
<td>90%</td>
</tr>
<tr>
<td>Stability</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>V</td>
<td>S</td>
</tr>
<tr>
<td>Trend</td>
<td>Z</td>
<td>D</td>
<td>Z</td>
<td>Z</td>
<td>D</td>
</tr>
<tr>
<td>Tau-U*</td>
<td>—</td>
<td>100%</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>PND</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td># of sessions</td>
<td>4</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td># lessons repeated</td>
<td>—</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>Jo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>0–20%</td>
<td>0–100%</td>
<td>100%</td>
<td>20–100%</td>
<td>60–80%</td>
</tr>
<tr>
<td>Mean</td>
<td>4%</td>
<td>76.7%</td>
<td>100%</td>
<td>68.9%</td>
<td>70%</td>
</tr>
<tr>
<td>Median</td>
<td>20%</td>
<td>90%</td>
<td>100%</td>
<td>80%</td>
<td>70%</td>
</tr>
<tr>
<td>Stability</td>
<td>V</td>
<td>V</td>
<td>S</td>
<td>V</td>
<td>S</td>
</tr>
<tr>
<td>Trend</td>
<td>Z</td>
<td>A</td>
<td>Z</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>Tau-U*</td>
<td>—</td>
<td>96.7%</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>PND</td>
<td>—</td>
<td>83.3%</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td># of sessions</td>
<td>5</td>
<td>12 (17*)</td>
<td>3</td>
<td>9 (14*)</td>
<td>2</td>
</tr>
<tr>
<td># lessons repeated</td>
<td>—</td>
<td>4 (9*)</td>
<td>0</td>
<td>4 (9*)</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: *denotes Tau-U between baseline and intervention (overall). *Jo had 9 sessions in which she attempted the independent portion; she had 5 sessions in which modeling and guided were done, but she was not independent enough during the guided portion to move into the independent phase (i.e., 14). *indicates the data is reported for sessions in which the student attempted the independent portion.
Discussion

This study explored the VA instructional sequence with regard to the acquisition and maintenance of solving fraction problems for three middle school students with mild intellectual disability and/or autism. Through a multiple probe across participants design, students received a minimum of three sessions using the app-based manipulative (i.e., virtual portion of the VA instructional sequence) and a minimum of five sessions using numerical strategies (i.e., abstract portion of the VA instructional sequence). The students were successful in acquiring and generally maintaining (i.e., accuracy scores higher than baseline and generally consistent with intervention) their performance in solving their respective fraction problems, although the abstract portion was challenging to one student in particular. In other words, a functional relation was found between the independent variable—the VA instructional sequence—and the dependent variable (i.e., accuracy on the fraction problems being taught).

Consistent with previous research examining virtual or concrete manipulatives used within an instructional sequence (i.e., the VRA or CRA), the students in this study successfully learned how to either add fractions with unlike denominators (Blair) or find equivalent fractions (Natalie and Jo; cf., Bouck, Bassette, et al., 2017; Bouck, Park, et al., 2017). Previous researchers found students with disabilities acquire different mathematics skills (e.g., making change with coins, fractions) when taught via a graduated sequence of instruction involving manipulatives (e.g., Bouck et al., 2016; Cass et al., 2003). Although predominantly graduated sequences of instruction involving manipulatives—the CRA or VRA—have targeted students with learning disabilities or more high-incidence disabilities (Bouck & Park, 2018), researchers also found these instructional sequences effective for students with intellectual disability and/or autism (Bouck, Bassette, et al., 2017; Bouck, Park, et al., 2017; Stroizer et al., 2015; Yakubova et al., 2016).

Although past research involving the manipulative-based graduated sequences have supported the acquisition of different mathematical concepts for students with disabilities, including mild intellectual disability and autism, researchers have found issues with maintenance. In previous research studies involving the virtual manipulative-based instructional sequences, students struggled with independently solving the different mathematical behaviors when explicit instruction and use of different representations did not proceed the independent attempts (e.g., Bouck, Park, et al., 2018). For students with more intensive mathematical needs, such as those with mild intellectual disability and/or autism, the general approach of three lessons at 80% for each phase of the graduated sequence might have been insufficient to aid in students maintaining the mathematics after the intervention ended. To address this, researchers targeted five sessions at 80% accuracy as mastery criteria for the abstract phase only, which more closely resembles the maintenance, aside from the explicit instruction of the numerical strategies proceeding the independent attempt. The move from the typical three sessions of mastery to transition from one phase to another within the graduated sequence of instruction was to reflect overlearning, an instructional strategy in which additional opportunities to practice occur past successful performance (Alberto & Troutman, 2009; Collins, 2012).

Implications for Practice

One implication for this study is that for students with more intensive mathematics needs, such as those with mild intellectual disability and/or autism—may benefit from additional sessions to achieve mastery in graduated systems of instruction involving manipulatives. The three students with mild intellectual disability and/or autism in this study needed to achieve 80% or higher for five abstract sessions, in contrast to the typical three sessions (Agrawal & Morin, 2016). The abstract sessions, with the exception of the explicit instruction of numerical strategies, more closely resembled the maintenance probes. This potential overlearning, a noted strategy for improving maintenance (Alberto & Troutman, 2009; Collins, 2012), may have resulted in the positive maintenance results. Related, one student (i.e., Jo) needed additional sessions in the abstract phase to achieve independence.
and mastery. Even when students seem to struggle with the mathematical content being presented, this study suggests perseverance. Some students, such as Jo, who struggle without representations may need additional opportunities for instruction when only using numerical strategies. Like Jo, students may be able to learn the mathematics when educators provide more instruction.

Another implication for practice is that teachers can use virtual manipulative based instructional sequences, such as the VA, to support secondary students with mild intellectual disability and/or autism to acquire mathematical content. Previous researchers found secondary students with disabilities prefer virtual manipulatives to concrete and, for this population, virtual manipulatives may be more age-appropriate and reduce potential stigmatization of using concrete manipulatives (Satsangi & Bouck, 2015; Satsangi et al., 2016). Along with the one other previous published study examining the VA instructional sequence (Bouck, Park, et al., 2017), this study lends support to this intervention. The benefit of the VA instructional sequence over the VRA instructional sequence is that it is more efficient (i.e., at least three sessions shorter as the representational phase is removed). With regard to fractions, the representational phase proved challenging and frustrating to students with disabilities in past research (c.f., Bouck, Bassette et al., 2017).

Limitations and Future Directions

One limitation of this study involves the limited examination of maintenance. Maintenance occurred only 2 weeks after the last intervention and in subsequent sessions. Future research should examine more longer-term maintenance, such as at 4 weeks and even up to and beyond 6 weeks. When students with mild intellectual disability and/or autism struggle to maintain, researchers may seek to include boost sessions, in which explicit instruction is provided to improve maintenance and even generalization to real-life situations (e.g., for fractions this might include baking). Researchers found boost sessions—in which instruction is provided periodically after intervention—to be effective in supporting maintenance (Kellems et al., 2016). Another limitation is the conduction of this study outside of a typical classroom and/or classroom instruction. Researchers worked one-on-one with participants and research activities occurred in the hallway. In the future, researchers should seek to explore the implementation of the VA instructional sequence within the classroom and/or typical classroom instruction, and to be implemented by a classroom teacher as opposed to a researcher. This would include delivery of the VA instructional sequence in a small group format, rather than just one-on-one. If researchers continue to implement the VA instructional sequence removed from typical classroom instruction, they should seek a generalization phase of solving the mathematical problems within the classroom. This study did not include a generalization phase in the classroom or with the teacher.

Given this study explored an adaptation to an instructional sequence—namely the removal of the representational phase—researchers should seek to determine if other types of adaptations result in acquisition and maintenance as well as if manipulatives are needed for students with intellectual disability and/or autism. In other words, does one need to start with virtual manipulatives (i.e., virtual phase), or can students be directly introduced to the abstract—or even representational—concepts, when explicit instruction is used. The researchers of this study maintain the value in using manipulatives to develop conceptual understanding (Carbonneau et al., 2013). Similarly, researchers should explore the utility of a fraction tile (part-whole fraction depiction) versus a number line app. A number line representation of fractions may be more advantageous than the part-whole, although research is needed regarding students with intellectual disability and/or autism (Tian & Siegler, 2017). A final limitation could be viewed as Jo’s struggles during intervention, particularly during the abstract portion of the graduated instructional sequence. Yet, the fact that Jo struggled is also realistic with regard to students who face significant challenges in mathematics. Both researchers and practitioners must consider if solving mathematical problems in the abstract is truly the most appropriate goal for all students with disabilities, or if such students might benefit with using ma-
manipulatives as a cognitive prosthesis (Edyburn, 2005, 2006).

References


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Investigating the Usage of Reading Curriculum-Based Measurement (CBM-R) to Formatively Assess the Basic Reading Skills of Students with Intellectual Disability

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Kevin Ayres
University of Georgia

Abstract: Curriculum-based measurement in reading (CBM-R) was developed in the 1980s and has been established as a valid means to measure students' progress towards acquiring reading skills in response to instruction (Ball & Christ, 2012). Efficiency of administration and cost-effectiveness add to the appeal of CBM-R. As a result, CBM-R is a popular progress monitoring tool used with students without disabilities and students with high incidence disabilities. Research on effective reading instruction for students with intellectual disability (ID) is increasing; however, research on measures for assessing student response to reading instruction remains limited. This article explores how CBM-R has been used as a progress monitoring tool to formatively assess the basic and integrated reading skills of students with ID. This review specifically examines how CBM-R has been administered to students with ID, including type of CBM-R used, presentation format, student response modality, and use of additional prompting and/or performance feedback. Eleven articles were identified for inclusion. Recommendations for future research are discussed.

The National Reading Panel (NRP, 2000) identified five key components for effective reading instruction: phonological awareness, phonics, vocabulary, fluency, and comprehension. Until recently, reading instruction for students with intellectual disability (ID) failed to embrace all of these components. Students with ID primarily received reading instruction in identifying disconnected text, also known as sight word instruction (Browder et al., 2006). Legislative mandates in the early 2000s called for a curricular shift, necessitating increased focus on instructing students with ID in core academic skills such as reading (Hunt et al., 2012). Recent research in this area indicates that students with ID can improve reading skills when provided intensive, systematic instruction in the five components of reading (Afacan et al., 2018; see Allor, Mathes, Roberts, Jones, & Champlin, 2010; Browder et al., 2008). As researchers develop new and potentially effective interventions, the research community must likewise determine how to best assess students' skills in response to intervention.

Simply adopting the same assessments used with other student populations may not be sufficient. Students with ID may lack test-taking skills, which may confound performance on reading assessments (Baker et al., 2010). Educators and school psychologists commonly use reading assessments such as Woodcock Reading Mastery Test (WRMT; Woodcock, 2011) and the Comprehensive Test of Phonological Processing (CTOPP-2; Wagner et al., 2013) to measure reading skills with other student populations. However, students with ID may not perform well on these types of reading assessments, in part because students with ID may have limited experience with the requirements typical of these types of assessments (e.g. working with a novel examiner, responding to limited prompts, omitting the response topography required by these types of assessments). These barriers may impact students' ability to show what they know.

Finally, students with ID may present with behavioral and communication barriers that
impact their ability to participate in formal reading assessments typically used with other populations (Jones et al., 2018). For example, some students with ID may have difficulty staying on task for sustained periods of time. Strict reading assessment administration instructions may limit the examiner’s ability to prompt and reinforce on-task behavior while managing challenging behaviors. Students with ID may have communication problems that a classroom teacher would typically handle with extra prompts, simplified directions, extended practice on sample items. However, formal reading assessments such as the WMRT and CTOPP limit the examiner’s ability to administer needed accommodations.

Research has indicated that students with ID can learn reading skills, although progress may be slower than that of students without ID (e.g., Allor et al., 2014). Formal reading assessments used with other student populations may not be sensitive to students’ emerging reading skills. A test administrator may have difficulty establishing a basal level with a student with ID when the student cannot complete the first three items on the test. The student has emerging skills, but possibly not enough to meet the basal level. Inability to establish the basal level means that reading skills cannot be evaluated using that particular measure. If a student fails to achieve the basal level on multiple measures, then options for formally assessing the student’s reading skills diminish. Once a student has sufficient reading skills to achieve a basal level on a measure, then options for formally assessing the student’s reading skills diminish. A test administrator may have difficulty establishing a basal level with a student with ID when the student cannot complete the first three items on the test. The student has emerging skills, but possibly not enough to meet the basal level. Inability to establish the basal level means that reading skills cannot be evaluated using that particular measure. If a student fails to achieve the basal level on multiple measures, then options for formally assessing the student’s reading skills diminish.

CBM-R may provide an answer to these assessments challenges. CBM-R originated in the field of special education as a means to measure the basic skills of students with learning disabilities in response to reading intervention (Deno, 1985). The initial intent of CBM-R was to give teachers a way to measure progress and make ongoing changes to instructional programs (Deno, 2003), although CBM-R may also be used for diagnostic purposes, program evaluation, and as part of assessment procedures for special education eligibility (Ball & Christ, 2012). Curriculum-based measurement is defined as a formative evaluation process used to measure basic skills (Deno, 2003), with an emphasis on achievement of major long term goals (Stecker et al., 2005). In 2003, Deno argued that using CBM-R to measure basic learning skills is equivalent to checking “vital sign indicators for learning” (p. 6).

CBM-R repeatedly measures the same discrete task using a variety of standardized stimulus materials (Deno, 2003). Alternate forms of the same CBM-R are administered regularly (e.g., weekly; Hosp et al., 2007). Results can be graphed over time as an index of change in student performance (Stecker et al., 2005). CBM-R is sensitive to inter- and intra-subject changes over time compared to other classroom reading assessments (Fuchs et al., 2007), in contrast to norm-referenced reading assessments, which are designed to produce scores that are stable over time (Hosp et al., 2007).

CBM-R are considered standardized assessments because measured behaviors are operationally defined and measurement procedures are consistently implemented (Fuchs et al., 2007). CBM-R employ direct, low-inference measures to assess performance and do not rely on norms against which to compare student performance (Hosp et al., 2007). For example, answers are either correct or incorrect and scores are expressed as the number of independent, correct items completed in a specified period of time (i.e. skill fluency). Additionally, CBM-R uses standardized administration procedures, such as scripted directions and examples, and specific timing rules (Hosp et al., 2007). This permits valid comparisons between earlier scores and scores following additional instruction.
CBM-R can be used to measure both basic reading skills and integrated reading skills. Skills-based CBM-R (Hosp et al., 2007) are also referred to as specific subskill mastery measurement (SSMMs; Ball & Christ, 2012) or proximal CBM (Jones et al., 2018). They are used to assess discrete, yet critical, reading skills such as phoneme segmentation, non-word blending, and letter sound fluency (Fuchs et al., 2007). General Outcome Measures (GOMs), another type of CBM-R, assess the integration of several basic skills to perform a more complex skill (Hosp et al., 2007). Use of the term GOM also indicates that stimulus materials are not directly aligned or do not come from a specific curriculum (Deno, 2014). Oral reading fluency (or passage reading fluency) is an example of GOM and is perhaps the most recognized form of CBM-R (Fuchs et al., 2007). Oral reading fluency (ORF) GOMs assess a student’s integration of decoding skills, vocabulary, and comprehension in order to fluently read a short passage (Hosp et al., 2007). Scores on ORF GOMs are used to make inferences about a student’s overall reading competency (Klingbeil et al., 2017). While some studies use ORF GOMs with students with ID, skills-based CBM-R may be useful for students who demonstrate emerging basic reading skills but are not yet able to integrate skills in order to read passages. Researchers suggest that CBM-R that is closely aligned to the specific skills targeted for instruction may be more sensitive to changes in student performance than GOMs, which assess generalization of discrete skills to read passages (Ardoin et al., 2016).

CBM-R has been used with a variety of student populations. It is commonly used within response to intervention frameworks with general education students who are struggling to read (Ball & Christ, 2012). Within special education, CBM-R has been used extensively with students with learning disabilities (Stecker et al., 2005). Researchers have explored its usage with students with sensory impairments (Wayman et al., 2007) and students with emotional and behavioral disorders (Fore et al., 2009). However, no synthesis on its use with students with ID exists. The purpose of this review is to examine the research literature evaluating the use of CBM-R with students with ID and to illustrate the ways that researchers have used CBM-R with this population to formatively assess changes in reading performance over time. The review specifically focuses on characteristics of the student participants, type of CBM-R used, presentation format, student response modality, how frequently CBM-R was administered, whether or not CBM-R were timed, and whether or not prompting or performance feedback were provided to the student.

Method

Electronic searches of the Education Research Complete, ERIC, and PsycNET databases were completed using combinations of the following terms: curriculum based measurement, curriculum-based measurement, curriculum based measure, curriculum-based measure, general outcome measure, progress monitoring, and reading. In order to capture the student population of interest, the following terms were also included in the search: intellectual disability, intellectual disabilities, mental retardation, significant cognitive disabilities, significant cognitive disability, developmental disability, and developmental disabilities. These searches yielded 460 articles. Article titles and abstracts were reviewed. The abstract needed to reference reading curriculum-based measurement and/or reading general outcome measurement and also reference participants with ID. If those terms were found in the abstract, the article was identified for further review. From this database search, 54 articles were retained for further review. An ancestral search was completed for any article identified for inclusion using the database search. Two additional articles were identified for inclusion through the ancestral search. The electronic databases were searched a second time, this time using frequently occurring author names as search terms.

In order to be included in the review, articles needed to be published in peer-reviewed journals. A study needed to include at least one participant with intellectual disability, as determined by author report of a participant’s medical diagnosis, educational eligibility, or author-documented cognitive functioning below 70. Studies had to use CBM-R to formatively evaluate the reading skills of students with ID. CBM administered only once during the study, or only used as pre- and post-intervention evaluation was excluded since that usage is not consis-
tent with the principles of formative assessment. Studies utilizing quasi-experimental designs (i.e., group or single-case design methodology) were included, as well as case studies where CBM-R was used to monitor student progress. A measure was considered to be CBM-R if it assessed a single task over a brief measurement session (e.g., less than 3 minutes), was administered repeatedly (i.e., more than two administrations) as formative assessment to the same student using alternate forms, and produced direct and easily interpretable (i.e., low-inference) data (Hosp et al., 2007). For the purpose of this paper, untimed CBM-R was included since several articles using CBM-R with students with ID used short duration measures but did not require students to adhere to strict time limits. Two studies were excluded (Allor, Mathes, Roberts, Cheatham, & Champlin, 2010; Allor, Mathes, Roberts, Jones, et al., 2010) because they reported data from the first two years of a research project, but a third article published in 2014 reported data from all four years of the project using the same participants (Allor et al., 2014). This third article was included in this review.

The first author identified 11 studies through database searches, author searches, and ancestral searches. The second author independently reviewed four randomly selected articles (36%) to determine reliability on article inclusion. Overall agreement was 100%. Articles were coded for the following information: participants, purpose of CBM-R usage, type of CBM-R used, and administration procedures including presentation format, student response format, frequency of administration, whether or not the administration was timed and for how long, and what (if any) prompting or performance feedback was provided to the student during the CBM-R administration. Coded information is summarized in Table 1.

Results

Participants

Eleven research studies were identified for inclusion within this review, with 267 participants with documented deficits in IQ. Two studies (Allor et al., 2014; Cawley et al., 1990) included participants with borderline IQ (i.e., IQ above 70) but did not specify how many participants had ID and how many were considered to have borderline IQ. Therefore, the number of participants with ID (i.e., IQ below 70) may be less than 267. All studies used CBM-R to measure the reading performance of students in elementary and/or middle school (e.g., Al Otaiba & Hosp, 2004; Hill & Lemons, 2015). No studies examined CBM-R for use with high school students exclusively.

Students with mild ID (i.e., reported IQ between 55-70) were included in three studies (27%). One study (9%) included students with moderate ID (i.e., reported IQ between 40-55). One study included participants with both mild and moderate ID. Four studies did not specifically state the severity of the participants’ ID. No studies included students classified as having severe or profound ID. While not considered as an ID, students with borderline IQ (i.e., reported IQ between 70-85) were included in three studies along with students with ID (Allor et al., 2014; Cawley et al., 1990; Jones et al., 2018).

Role of CBM-R in the Study

This review was solely concerned with CBM used for formative assessment of student response to instruction. In five studies, CBM-R was used to measure students’ growth in reading in response to business-as-usual reading instruction. In other words, nothing about reading instruction was altered for the study. Frank and Gerken (1990) studied the sensitivity of CBM-R for measuring changes in reading performance for students with ID and comorbid mental health conditions. Hill and Lemons (2015) investigated whether special education teachers could administer CBM-Rs reliably and how well leveled CBM-R assessments captured growth in students’ reading skills. However, reading instruction was not altered in this study.

Six studies used CBM-R to measure student response to new reading interventions. All six studies implemented multi-component reading interventions, focusing on skills such as phonemic awareness, decoding, comprehension, and vocabulary. CBM-Rs were used to assess students’ progress in response to these new interventions. Finally, one study specifically investigated variations in CBM-R presentation on student performance. Jones et al.
<table>
<thead>
<tr>
<th>Authors and Year</th>
<th>Participants</th>
<th>Skills Assessed Using CBM(s)</th>
<th>Source</th>
<th>Presentation Format</th>
<th>Student Response Modality</th>
<th>Frequency of Administrations</th>
<th>Timing</th>
<th>Prompts or Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cawley et al. (1990)</td>
<td>n = 66 (28 students with mild ID) 12-15 years old</td>
<td>ORF, answering comprehension questions based on ORF passage</td>
<td>Researcher-created passages pulled from science curriculum</td>
<td>Visual (paper)</td>
<td>Vocal</td>
<td>Weekly</td>
<td>Yes (1 min)</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Frank et al. (1990)</td>
<td>n = 3 students with mild ID 11 years old</td>
<td>ORF</td>
<td>Researcher-created passages based on curriculum materials</td>
<td>Visual (paper)</td>
<td>Vocal</td>
<td>6 administrations total</td>
<td>Yes (1 min)</td>
<td>No</td>
</tr>
<tr>
<td>Faykus et al. (1998)</td>
<td>n = 6 students with mild ID and mental health diagnosis 11-16 years old</td>
<td>ORF, Maze</td>
<td>Researcher-created</td>
<td>Visual (ORF -- paper, MAZE -- computer)</td>
<td>Vocal (ORF), select from field of 3 (MAZE)</td>
<td>Twice weekly</td>
<td>Yes (ORF 1 min, MAZE 2.5 min)</td>
<td>Progress graph and goal were shown to students before CBM was administered</td>
</tr>
<tr>
<td>Al Otaiba et al. (2004)</td>
<td>n = 4 students with DS 7-12 years old</td>
<td>ORF, sight word reading fluency, letter sound fluency</td>
<td>Researcher-created</td>
<td>Visual (paper)</td>
<td>Vocal</td>
<td>Weekly</td>
<td>Yes (1 min)</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Lemons et al. (2010)</td>
<td>n = 24 students with DS and mild or moderate ID</td>
<td>Letter sounds, sight words, decodable words, nonsense words</td>
<td>Researcher-created</td>
<td>Visual (paper)</td>
<td>Vocal</td>
<td>11 administrations total (approximately every 3rd day)</td>
<td>No</td>
<td>Letter sounds–teacher pointed to each sound. Feedback was provided for correct and incorrect answers. Reinforcement was also provided for on-task behaviors in the form of tokens.</td>
</tr>
<tr>
<td>Lemons et al. (2012)</td>
<td>n = 15 students with DS 5-13 years old</td>
<td>ORF, ISF, letter sounds, blending, segmenting</td>
<td>ORF- DIBELS (2002), all other CBMs were researcher-created (ISF adapted from DIBELS 2002)</td>
<td>ORF, letter sounds, blending -- visual, segmenting -- oral ISF -- visual and oral</td>
<td>ORF, Letter sounds, Blending, Segmenting -- visual, ISF -- visual and oral</td>
<td>daily in baseline condition, half of CBMs administered on alternating days in intervention</td>
<td>Yes (ORF 1 min)</td>
<td>All other CBMs were untimed</td>
</tr>
</tbody>
</table>
### TABLE 1—(Continued)

<table>
<thead>
<tr>
<th>Authors and Year</th>
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<th>Skills Assessed Using CBM(s)</th>
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<th>Frequency of Administrations</th>
<th>Timing</th>
<th>Prompts or Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allor et al. (2013)</td>
<td>$n = 3$ students with moderate ID 8–12 years old</td>
<td>PSF, ORF, NWF, word reading fluency</td>
<td>PSF, ORF, NWF - DIBELS (2002) Word reading fluency - researcher-created</td>
<td>ORF, NWF, word reading fluency - visual (paper) PSF - oral</td>
<td>Vocal</td>
<td>Daily</td>
<td>Yes (1 min)</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Allor et al. (2014)</td>
<td>$n = 141$ (76 in treatment group), mild ID, moderate ID, or borderline IQ 1st–4th grade</td>
<td>PSF, ORF, NWF</td>
<td>DIBELS (2002) ORF, NWF - visual (paper) PSF - oral</td>
<td>Vocal</td>
<td>Monthly (letter naming fluency presented pre- and post-intervention)</td>
<td>Yes (1 min)</td>
<td>Not indicated</td>
<td></td>
</tr>
<tr>
<td>Hill et al. (2015)</td>
<td>$n = 38$ students with ID 9–15 years old</td>
<td>Word reading fluency, ORF</td>
<td>EasyCBM (word reading fluency levels K–3, ORF levels 1–5)</td>
<td>Visual (paper)</td>
<td>Vocal</td>
<td>Weekly</td>
<td>Yes (1 min)</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Jenkins et al. (2017)</td>
<td>$n = 56$ (2 with ID) 2nd–6th grade</td>
<td>ORF</td>
<td>aimWeb (33 passages), Edcheckup.com (9 passages)</td>
<td>Visual (paper)</td>
<td>Vocal</td>
<td>Schedule varied, but intermittently</td>
<td>Yes (1 min)</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Jones et al. (2018)</td>
<td>$n = 6$ (3 with DS and moderate ID, 3 with ASD/ borderline IQ) 5–11 years old</td>
<td>Word reading fluency</td>
<td>Researcher-created</td>
<td>Visual (paper, PowerPoint, or flashcards)</td>
<td>Vocal</td>
<td>3 times per presentation format</td>
<td>No</td>
<td>Verbal and nonverbal prompts to regain attention or to encourage on-task behavior</td>
</tr>
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</table>

(2018) examined variations in presentation format for word reading fluency CBM-Rs (e.g., words presented on flashcards, PowerPoint slides, or in word lists). Dependent variables in the study included student time spent on-task and engaged during CBM-R administration, number of prompts needed for the student to remain on task, and accuracy of CBM-R in measuring known words.

**Types of CBM-R Used**

In 11 studies, 27 different CBM-R measures were administered. Three studies utilized a single CBM-R to measure student reading performance. Two of those studies used only oral reading fluency CBM-R (Frank & Gerken, 1990; Jenkins et al., 2017). Oral reading fluency is considered to be a "capstone task" because it is an integration of several discrete reading skills (Hosp et al., 2007, p. 32). Jones et al. (2018) used word reading fluency CBM-R to investigate differences in presentation format. The remaining eight studies utilized more than one CBM-R to measure student progress.

Many CBM-Rs evaluated fluency at the word level or higher. ORF (also referred to as passage reading fluency, where students are asked to read an entire passage of text) was the most frequently utilized CBM-R, used in nine of the 11 included studies (82%). Four studies (36%) used CBM-Rs to measures word reading fluency, which could include decodable word reading and/or sight word (i.e., non-decodable words, such as *said*) reading (e.g., Lemons & Fuchs, 2010). Three studies (23%) used CBM-R to assess nonsense word reading fluency (i.e., made up words such as *mip*; e.g., Allor et al., 2013). Three studies (27%) assessed students’ ability to segment spoken words into smaller components, also known as phoneme segmentation or stretching (i.e., when told a word, the student has to segment the words into individual phonemes, “cat” becomes “/c/ /a/ /t/”). Letter sound fluency was assessed in three studies (27%). Letter sound fluency measures how quickly a student can state a letter’s sound when shown a letter or list of letters. Finally, one study utilized Maze CBM-R. In Maze CBM-R, the student is provided a passage with every 6th-7th word omitted. While reading the passage, the student stops to select the correct word to complete the sentence from an array of three choices (Faykus & McCurdy, 1998).

CBM-R was initially designed to be an assessment that a teacher could create using the same curricular materials being used for instruction (Deno, 2014). In other words, the assessment materials and CBM-R stimuli would be sampled from the learning materials. In this vein, six studies (55%) utilized CBM-R created by the researchers. In one study, researchers created ORF passages using the science textbook already being utilized in the classroom (Cawley et al., 1990). Frank and Gerken (1990) utilized passages selected from a basal reader.

Three studies solely relied on CBM-Rs sold commercially, such as the Dynamic Indicators of Basic Literacy Skills (DIBELS, Good & Kaminski, 2002, used in Allor et al., 2014), easyCBM (University of Oregon, 2009; used in Hill & Lemons, 2015), and aimsWeb (Shinn et al., n.d., used in Jenkins et al., 2017). Tasks using commercially available CBM-R tend to sample all of the possible stimuli in the skill set assessed in the CBM-R. For example, the easy-CBM letter sound fluency CBM-R (University of Oregon, 2009; used in Hill & Lemons, 2015) includes every possible individual letter and letter combination in printed English.

Finally, two studies utilized both commercially available and researcher-created CBM-Rs (e.g., Allor et al., 2013; Lemons et al., 2012). Allor et al. (2013) used DIBELS CBM-Rs in addition to researcher-created word reading fluency CBM-Rs, using words from the student’s instructional materials (i.e., stories). Lemons et al. (2012) used DIBELS ORF in addition to researcher-created CBM-Rs, including a letter sound fluency task that sampled the eight specific letter sounds being taught in the reading intervention program.

**Administration Procedures**

**CBM-R presentation format.** CBM-Rs such as word reading fluency and ORF typically rely on a visual presentation (i.e., CBM-R stimuli are presented on paper or in another visual format). Nine studies used 22 CBM-Rs where stimuli were presented visually, either on paper or cardstock (e.g., Cawley et al., 1990, Jenkins et al., 2017), or by computer (Faykus
Jones et al. specifically investigated how variations in presentation format influenced student performance. Researchers alternated between word reading fluency CBM-R presented using individual words displayed on flash cards, individual words displayed on PowerPoint slides, or all words presented in columns on a standard sized piece of paper.

Fewer studies utilized CBM-Rs relying on oral presentation of CBM-R stimuli. All four studies using a CBM-R relying on oral presentation utilized phoneme segmentation CBM-Rs. Phoneme segmentation CBM-Rs typically proceed as follows: an adult vocalizes a word, then the student responds by vocalizing all the sounds in the word. No study included in this review relied solely on orally-presented CBM-Rs to measure student performance. Rather, orally presented CBM-Rs like phoneme segmentation were used with other visually presented CBM-Rs like ORF, letter sound identification CBM-Rs, and word reading fluency CBM-Rs.

In one study, the researchers modified a CBM-R that traditionally relies on oral presentation to include visual supports. Lemons et al. (2012) modified the initial sound fluency task (originally from DIBELS; Good & Kaminski, 2002) to include pictures. Typically, initial sound fluency CBM-Rs begin with an adult vocalizing a word and the student responding by vocalizing the first sound heard in the word. Lemons et al. (2012) showed a student four picture cards. The student was asked to name the items depicted on the cards. Then the instructor asked the student to select the card showing the word that started with a particular sound (i.e., "which picture begins with /b/?").

**Student response format.** Nine studies utilized CBM-Rs that required students to respond vocally. Lemons and Fuchs (2010) specifically addressed how student speech articulation errors were accommodated and scored on CBM-Rs requiring a vocal response. The final two studies used various CBM-Rs to measure reading performance, some CBM-Rs required vocal responses while others required gestural or touch responses.

**Frequency of CBM-R administration.** CBM-Rs are generally designed to be administered repeatedly for use in formative assessment of student progress. The frequency of CBM-R administration varied considerably within the included studies. Administrations occurred as frequently as daily (n = 1; Allor et al., 2013), several times per week (n = 3; e.g., Lemons & Fuchs, 2010), weekly (n = 3; e.g., Hill & Lemons, 2015), or monthly (n = 1; Allor et al., 2014). Jones et al. (2018) administered the CBM-Rs three times per presentation format (i.e., flashcards, word lists on paper, PowerPoint slides). Jenkins et al. (2017) systematically altered how frequently CBM-Rs were administered to determine which schedule resulted in accurate decision making. In this study, the frequency of administration varied from once per week to once every sixth week. Frank and Gerken (1990) administered CBM-Rs six times total, but did not specify the interval between administrations.

**Timing.** CBM-Rs are traditionally timed assessments. In other words, students are not permitted to continue responding after a set period of time elapses. Seven studies (64%) utilized time limits to administer all CBM-Rs used in the study. Studies that utilized commercially available CBM-Rs (i.e., DIBELS; Good & Kaminski, 2002) generally adhered to the time limits set by the publisher (e.g., Hill & Lemons, 2015; Jenkins et al., 2017). Two studies identified for this review used short duration measures (less than 5 minutes) but did not stop students from responding after an elapsed period of time (Lemons & Fuchs, 2010; Jones et al., 2018). One study utilized both timed and untimed CBM-R (Lemons et al., 2012). Finally, one study did not indicate if CBM-R were timed or untimed (Al Otaiba & Hosp, 2004), however, this study was included because the article indicated elsewhere that the CBM-Rs were short duration measures.

**Prompts and feedback.** Typically, no prompting or performance feedback is given during the CBM-R administration, as this would adversely affect fluency scores. CBM-Rs are standardized assessments, usually with specific instructions limiting what the administrator may say or do during the administration. Eight studies included in this review either indicated that CBM-R were administered as prescribed (in the case of commercially produced CBM-R) or did not indicate if any additional prompts or feedback were given.

Two studies provided specific details regard-
ing the provision of prompts or feedback during the CBM-R administration. In a study by Lemons and Fuchs (2010), CBM-R administrators provided a variety of prompts. During the letter sound fluency task, the administrator pointed to each letter as the student vocalized letter sounds. The administrator also provided corrective and positive feedback throughout the CBM-R. The CBM-Rs used in this study were also untimed. Jones et al. (2018) used both verbal and nonverbal prompts to regain the student’s attention when he/she stopped responding. They also used prompts to encourage and maintain on-task behavior.

Finally, one study investigated the use of performance feedback on students’ future performance on CBM-R tasks (Faykus & McCurdy, 1998). In one condition, prior to administering the CBM-R, a student was shown his/her progress graph from previous CBM-R administrations relative to the student’s goal line. Performance feedback was not provided during the CBM-Rs and the CBM-Rs were timed (1 min for ORF, 2.5 min for computer-based Maze).

Discussion

What science knows about the development of reading skills amongst individuals with ID is limited but growing. Recent work using CBM-R to assess reading skill development has begun to yield information relative to emergence of early literacy and the efficiency of reading instruction to bring about those changes. The purpose of this literature review was to explore and summarize how reading CBM-R has been used to assess the reading skills of students with ID. Specifically, we sought to investigate the types of students who are being assessed using reading CBM-Rs, the specific reading CBM-Rs being used, and the administration procedures used with this group of students.

Participants

The 11 included studies provide evidence that various reading CBM-R can be effectively used to measure the basic reading skills of students with ID, specifically, students classified as having mild and moderate ID. None of the studies identified for inclusion looked at students with severe intellectual disability. This may be a reflection of the research literature, where there are only a few studies on teaching reading to students with severe intellectual disability (Browder et al., 2008). Alternatively, CBM-R in its current form(s) may not meet the accessibility needs of students with severe ID, who have more complex learning and communication needs than their peers with mild and moderate ID. More research is needed to determine how reading CBM-R needs to be modified to meet students’ access needs as well as how to tailor reading CBM-R to closely match students’ instructional levels and rates of reading skill development.

Classifying students with ID into groups based on IQ score is convenient, but obscures the heterogeneity within and across categories. Many studies here focus on students with mild ID (generally defined as IQ scores between 55-70). Some researchers argue that students with mild ID demonstrate cognitive skills and patterns of academic performance that are distinctly different from students with ID with IQ scores below 55 (Bouck & Satsangi, 2015). A few studies also included students with borderline IQ. It is likely that students with borderline IQ also demonstrate very different skills and patterns of performance compared to students with mild ID. Future research should investigate how reading CBM-R can best be used with these distinctly different groups of students.

Types of CBM-R Used

While studies used CBM-Rs that assess the integration of several reading skills (e.g., oral reading fluency CBM-R), this does not mean that CBM-Rs should be used exclusively with students who can read with fluency at the sentence level or higher. CBM-Rs that assess discrete reading skills (e.g., letter sound identification and non-decodable word reading fluency tasks) can and should still be used to monitor progress for students who cannot yet meaningfully participate in integrated skills CBM-Rs like oral reading fluency and MAZE. Students with ID may require significantly more time than students without ID to show progress on discrete skills CBM-Rs, which will require using these measures for far longer than they would typically be used with stu-
Allor et al. found that almost three years of instruction were required before some students could demonstrate performance on CBM-R consistent with the first grade reading benchmarks (Allor, Mathes, Roberts, Cheatham, et al., 2010). The studies here provide evidence that CBM-Rs can be sensitive to gradual and incremental progress in reading skill acquisition that may be characteristic of this population. However, Lemons et al. (2013) acknowledge that CBM-R may need to be modified for students who are just beginning to develop basic reading skills. For example, a student with ID may demonstrate mastery of only eight letter sounds in six months’ time. To repeatedly administer a CBM-R that assesses considerably more than eight letter sounds may result in frustration and poor performance. Limiting the CBM-R stimuli to mastered items and items targeted for instruction in the near future is also known as proximal curriculum-based assessment (Jones et al., 2018). This is in contrast to the general outcome measures common to commercially produced CBM-R (also known as distal curriculum-based measurement; Jones et al., 2018) which present the entire range of stimuli. Proximal curriculum-based measurement tailored to the specific intervention used with the student will be more sensitive to changes in student performance than GOMs or distal curriculum-based measurement (Ardoin et al., 2008). Developing CBM-Rs tied to an individual student’s instructional program may require more effort for teachers and may make cross-study comparisons difficult for researchers. However, administering an assessment that reflects the teacher’s instruction and the student’s progress in response to instruction is more important. Ultimately, this returns to the original intention of CBM-R, which strictly focused on measuring the actual skills that students were learning in classrooms.

Administration Procedures

Presentation format. Twenty-seven CBM-Rs were used in this review, and 22 of those CBM-Rs relied on visual presentation (i.e., the stimuli was presented on a paper or card). In one study, a CBM-R that is traditionally presented orally was modified with additional visual supports (i.e., pictures; Lemons et al., 2012). Students with ID may have deficits in attention, working memory, and receptive language (Hronis et al., 2017). These deficits would likely negatively impact performance on orally presented CBM-Rs, such as phoneme segmentation tasks. Visual presentation of the CBM-R and/or the use of supplemental visual supports, such as the ones used in Lemons et al. (2012), may lessen the impact of these deficits on students’ performance on reading CBM-R. Modification to some CBM-Rs, such as phoneme segmentation CBM-Rs, may not be easy to achieve without inflicting unwanted effects on the validity of the measures.

Solely relying on visual presentation is likely not enough to ensure students’ optimal performance on CBM-R. Special attention should be paid to how CBM-R materials are visually presented to students with ID. Students with ID may have difficulty focusing on relevant stimuli and ignoring irrelevant stimuli (Hronis et al., 2017). These deficits may negatively impact student performance on visually presented CBM-R that contain multiple stimuli on a page, such as lists of words or letters. Jones et al. (2018) explored variations in number of stimuli presented at a time on a word reading fluency CBM-R, evaluating the presentation of one word at a time versus columns of words that may be typical of traditional word reading fluency CBM-Rs.

Comorbid sensory impairments are not uncommon among students with ID (Durando et al., 2017). Future research should investigate modifications to reading CBM-R to meet the needs of learners with sensory impairments while still maintaining the validity of CBM-R. In order to meet the needs of more students with ID, future research should focus on how to modify visually and orally presented CBM-R to meet the needs of students with ID who also having sensory impairments, including visual impairments and hearing impairments. These advances would possibly benefit learners with sensory impairments who do not have ID.

Response format. Many types of reading CBM-Rs require vocal responses, such as oral reading fluency, word reading fluency, and phoneme segmentation. Most studies included here used reading CBM-Rs with students responded vocally. However, many students with ID cannot consistently vocalize
responses, or present with speech articulation issues that impact intelligibility, or have motor planning issues that impact the ability to vocalize quickly. Some students with ID rely on other, non-vocal forms of communication. These students could not participate in CBM-Rs that require vocal responding. CBM-R needs to be accessible to all students (Wallace & Tichá, 2007), especially students with ID who may lack a vocal repertoire. One study excluded from this review because it did not use CBM for formative assessment was specifically focused on reading instruction and assessment for students with limited vocalizations or students who used AAC to communicate (Ahlgrim-Delzell et al., 2016). They subsequently created and utilized CBM-Rs where students could gesture or touch to indicate a response. More research is needed to develop CBM-R measures that permit non-vocal responses (e.g., pointing, eye gaze).

Frequency of administration. Seven of the 11 studies administered CBM-Rs at least once per week (e.g., every 3rd day; Lemons & Fuchs, 2010). This is consistent with Deno’s initial recommendations of several times per week (Mirkin et al., 1982). In the study by Jenkins et al. (2017), the authors sought to determine how frequently CBM-R needed to be administered to reflect accurate progress in response to reading intervention. In that study, they found that CBM-Rs administered more frequently (e.g., multiple times per week up to weekly) were no more accurate than CBM-Rs administered once every two weeks. While the majority of the participants in Jenkins et al. were students with specific learning disabilities (not ID), their results suggest that future research should investigate the frequency of administration with students with ID. Time spent administering CBM-Rs is time not spent providing reading instruction. Their findings that less frequent administrations are just as informative have important practical implications in special education classrooms where teachers are already strapped for time.

Timing. CBM-Rs are intended to measure skill fluency, which is expressed as number of correct responses per period of time. The majority of the studies included in this review used timed CBM-Rs \( (n = 9, 69\%) \). However, three studies did not adhere to strict time limits for all administered CBM-Rs (e.g., Lemons et al., 2010). For the purpose of this review, studies using untimed CBM-Rs were included because there appeared to be a trend in the literature of administering untimed CBM-Rs to students with ID, while still adhering to the central tenet of CBM-R of short duration assessments. The question remains, when the CBM-R is untimed, is the measure still considered CBM-R? Or is it something else? Regardless of the reasons for timing or not timing CBM-R-type assessments, fluently performing basic reading skills is required for successful reading therefore should be a priority for students with ID who are learning to read. Students with ID should be instructed to fluency on basic reading skills, and assessment of those reading skills should emphasize assessing fluency.

When a CBM-R is timed, using the same limits that would be used for students without ID, do students with ID have enough time to respond and demonstrate competency? Does it make sense to administer extended time CBM-Rs, consistent with instructional accommodations that might be offered through a student’s IEP? If extended time is given in a standardized fashion (i.e., student is always permitted three minutes to complete the CBM-R when most students only have one minute to complete the CBM-R), then it should still be possible to make within-student comparisons across CBM-R administrations. More research is needed to identify how much extra time is beneficial for students with ID. Without an empirical answer to this question, the decisions regarding if and when to administer extended time CBM-Rs should likely be made on a case-by-base basis, considering how much extra time the individual student needs to respond in other assessment tasks.

Prompts and feedback. Ten of the studies included administered CBM-Rs as prescribed: no prompting or feedback for correct or incorrect answers was given to the student during the CBM-R administration. Prompts or feedback would take additional time and impact the student’s ability to respond to as many test stimuli as possible within the time frame, which would impact fluency scores. Difficulties sustaining attention and responding without prompting may also mask the student’s true fluency and impact CBM-R’s technical adequacy for use with this student. How-
ever, students with ID may require additional prompting to stay on task and continue responding during the assessment (Jones et al., 2018). In a study that was considered but ultimately excluded from this review, Wallace et al. (2010) implemented a four-tier prompt hierarchy to prompt students who failed to respond or stopped responding to CBM-R stimuli. Ardoin et al. (2008) described how providing consistent and ongoing reinforcement contingent on the student’s best effort might result in more consistent performance on CBM-R over time. Incorporating extended time (and keeping that extended time consistent across CBM-R administrations) would allow for additional time to prompt responding and praise the student’s continuous effort. This may be required to elicit the student’s best performance on the measure. Future research should explore the efficacy of this type of prompting for students with ID. Finally, future research should examine the impact of performance feedback (e.g., informing student of number items correct or incorrect) on the future CBM-R performance of students with ID. There is growing research in the provision of performance feedback during CBM-R with other student populations (e.g., Eckert et al., 2006).

**Limitations**

There are a number of limitations that should be considered for this review. The search process may not have identified all studies where CBM-R was used with students with ID. The inclusion criteria of specifically referencing CBM-R within the article may have eliminated articles that used dependent measures consistent with the principles of CBM-R (e.g., brief assessments of basic skills, administered repeatedly), but did not specifically refer to these measures as CBM-R. A consolidated definition of CBM-R was developed for this review, however, inclusion criteria used in this review may exclude principles of CBM-R that others may deem critical, or place emphasis on certain principles that others may deem non-critical. For example, some educational researchers would argue that CBM-R must be timed. However, given that some students with ID may require additional time to respond to task directions or emit vocal responses, the decision was made to include studies that used both timed and untimed CBM-Rs in this review. An additional criterion for inclusion was that the CBM-R had to be administered repeatedly for use as formative assessment. Some studies screened for this analysis used measures generally consistent with the premise of CBM-R in order to evaluate the performance of students with ID, but the measures were only administered one time or were administered only pre- and post-intervention, thereby not meeting the inclusion criteria of repeated administration of CBM-R in order to assess changes in performance over time (e.g., Tindal et al., 2003).

Several studies included in this review also included other student populations in addition to including students with ID. For example, two studies included both students with ID and students with borderline IQ, but did not specifically state how many students in the groups had borderline IQ (e.g., Allor et al., 2014; Cawley et al., 1990). The conflation of these two populations may not reflect the distinct learning differences between the two groups. On the other hand, specifically limiting the search to students with intellectual disability may have effectively excluded students with other primary eligibilities who may perform in academically similar ways to students with ID (e.g., ASD without reference to comorbid ID).

**Implications for Practice**

Although this review identified only 11 articles, the findings show promise for using reading CBM-R to assess the reading skills of students with ID. CBM-R was designed for teachers to monitor student progress and make changes to instructional programs as needed. This is in alignment with the IEP process, which requires teachers to demonstrate that students are making progress towards IEP goals and objectives. Teachers of students with ID can and should use formative assessments like CBM-R for instructional decision-making. Use of CBM-R and other formative assessments for planning and monitoring instruction has potential to improve the quality of academic instruction for students with ID. Some recommendations for CBM-R implementation are presented below.
First, because individuals with ID vary so greatly, the decision of what CBM-R to use and how to use it should be based on the needs of the individual student. Teachers should select CBM-Rs that reflect the student's current skill level. Selecting CBM-Rs that are above or below the student's current level may result in frustration, which will affect the student's performance on the CBM-R. Second, selected CBM-Rs should be aligned with the student's reading instruction. Teachers should select CBM-R tasks that are similar to activities the student completes during reading instruction, or create instructional activities that mimic the CBM-Rs that will be used for assessment. Teachers may want to utilize CBM-Rs that are already being used in their schools in order to save time and costs. Those CBM-Rs may need to be modified to be accessible to students with ID. If the school’s CBM-Rs do not meet the students’ needs, teachers can quickly create their own CBM-Rs, tailored to meet the unique needs of their students. Also many published CBM-Rs are available online, with a small portion of the product available for free. These free samples would allow teachers to test out a particular CBM-R with a student before purchasing it.

Before implementing CBM-R for the first time, teachers should consider the student’s prior history with educational assessments. Students with ID may have limited experience with reading CBM-R and similar measures, lacking the access skills to effectively “show what they know” (Jones et al., 2018). Teachers may need to spend time teaching students to participate in these assessments. For example, students with ID may need training for how to respond to standardized directions and how to respond to test stimuli. For a student new to a particular CBM-R, the first few administrations may reflect decreased scores as the student becomes familiar with the new task. Growth after a few data points could reflect changes due to instruction or the student’s acclimation to the measure.

When using CBM-R, teachers should consider the length of time the student requires to formulate responses and how much prompting the student will require to respond to test stimuli. If needed, teachers should allow extended time but administer that extended time systematically (i.e., the same across all CBM-R administrations) so that valid comparisons can be made across administrations. While CBM-R may be an efficient and sensitive means to measure changes in reading performance, teachers should consider using CBM-R in combination with other formative assessments in order to paint a complete picture of how the student’s skills are changing in response to reading instruction.

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*Articles included in review


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Multiple evidence-based interventions (EBIs) for children with autism spectrum disorder (ASD) have been identified based on their scientific validation. When interventions are used with culturally and linguistically diverse (CLD) children, less is known about the interaction between the cultural practice of intervening and sociocultural aspects of learning. Middle-class White communities in North America are among the most likely to participate in intervention research (Artiles et al., 2010; Arzubiaga et al., 2008; Rogoff, 2003). Thus, in order to effectively and appropriately serve CLD children with ASD using culturally and linguistically responsive EBIs, researchers must first examine the extent to which EBIs have included culturally diverse populations across a range of contexts (Bernal et al., 2009; Kim, 2016). Doing so allows researchers to expand ecological and social validity of existing EBIs and understand effective strategies for adaptation and accommodation, addressing the needs and expectations of different population subgroups (Artiles et al., 2010; Kim, 2016).

According to the National Autism Center ([NAC]; 2009), researchers identify EBIs by reviewing the extant literature on particular interventions for efficacy with individuals with ASD. They also study the values of diverse stakeholders (e.g., families, neighbors, or teachers) and feasibility of the intervention, which are both components that contribute to the larger constructs of both ecological and social validity. Ecological validity itself “refers to the extent to which the environment experienced by the subjects in a scientific investigation has the properties it is supposed or assumed to have by the investigator” (Bronfenbrenner, 1979, p. 29). Social validity “refers[s] to the degree of acceptance for the immediate variables associated with a procedure or program designed to change behavior” (Carter, 2010, p. 2). Wolf (1978) defined the social validity as (a) “the social significance of the goals,” (b) “the social appropriateness of the procedures,” and (c) “the social importance of the effects” (p. 207). Understanding an intervention’s ecological and social validity provides insight into the extent to which EBIs are aligned with stakeholders’ comfort with strategy for implementation (i.e., appropriateness of procedure). Further, stakeholders’ cultural beliefs and practices can inform expecta-
tions of intervention outcomes (i.e., goals) and the emphasis on a child’s social and behavioral change (i.e., importance of effect).

In the current investigation, application of the NAC (2009) guidelines for identifying EBI resulted in the identification of pivotal response treatment (PRT) as an effective intervention for teaching social skills for children with ASD. A review of PRT studies, however, revealed limited inclusion of culturally and linguistically diverse participants. The purpose of the larger, mixed methods study was to examine the implementation of PRT with four Korean American (KA) children, aged 5-10 years, with ASD. Along with the experimental investigation, we qualitatively evaluated the feasibility and applicability of PRT with the KA participants with ASD and their families. KAs are an understudied yet growing part of the group of Asians, a U.S. racial minority that is currently overrepresented on the autism spectrum while underrepresented in most other disability categories (Marks & Kurth, 2013).

PRT was developed to increase the motivation of children with ASD to acquire several critical social skills, including language, play, and peer relationships (Koegel et al., 1987). In particular, PRT has been successfully used to promote social behaviors of children with ASD, facilitating the generalization and maintenance of newly acquired skills through natural reinforcements (Stahmer, 1999). Results from this single case research, published in a separate article (Kim, 2017), largely align with the extant literature demonstrating the efficacy of PRT. In brief, focal KA participants were paired with four typically developing peers of similar ages who attended the same community-based programs. Peers were trained to engage in play sessions by the first author using modified PRT manuals. Results indicated that both the KA children with ASD and trained peers showed increased frequency of social interactions and increased positive affect (Kim, 2017).

The current analysis, a core part of the mixed method study, qualitatively examined the ecological and social validity of PRT with the families of KA children with ASD. Both ecological and social validity were conceptualized as indicators of the culturally responsiveness of PRT. The first author, bilingual in Korean and English, examined the KA stakeholders’ value and acceptance of the intervention (i.e., social validity) and the community contexts as a setting for PRT (i.e., ecological validity). The central question on the effectiveness and cultural responsiveness of PRT, responds to calls for increasing both the numbers of cultural and linguistic minorities as participants in intervention research and the diversity of the researchers themselves (Arzubiaga et al., 2008; August & Hakuta, 1997; Kim, 2016; Trainor & Bal, 2014).

Studying the implementation of PRT with KA families contributes to the research base in multiple ways. Asian American children, of which KAs are a subgroup, have a risk ratio of 1.15 of ASD identification when compared to all other races/ethnicities combined. Moreover, ASD is the third most common disability among Asian Americans (U.S. Department of Education & U.S. Office of Special Education and Rehabilitation Services, 2015). Asian Americans are also the least likely to receive special education for any disability, and consequently are often omitted from special education research. Although this study’s sample was not homogenous, focus participants for this study shared historical, cultural, immigration and linguistic backgrounds. Multiple, similar case sampling allows for in-depth analysis of those factors that are shared by the cases (Patton, 2015). The examination of social and ecological validity enriched the contexts of intervention implementation, an important aspect of culturally responsive research (Arzubiaga et al., 2008; Kim, 2016; Trainor & Bal, 2014).

Method

Two research questions guided this investigation: (a) How do KA stakeholders perceive the PRT intervention in terms of its social validity (e.g., goals, procedures, effects)? and (b) How is ecological validity represented in this community’s context? A case study design (Stake, 2000) was conducted for an in-depth examination of KA stakeholders’ participation in and perceptions of PRT. The focal research participants were four KA children with ASD. Additional participants included the focal children’s family and friends, including par-
Conceptual Framework

Bronfenbrenner’s ecological system theory (1979, 2005) is well-known for explaining how individuals develop in and interact with cultural contexts (Garcia & Dominguez, 1997; Trainor & Kim, 2013; Trainor et al., 2008). The framework explains five systems of interactions: micro-, meso-, exo-, macro-, and chrono-systems (Bronfenbrenner, 2005). The theoretical frame provided a critical lens, guiding decisions in participant selection, protocols development, data analysis, and interpretation of results and implications (Bernal et al., 2009). The validity of the investigation is, in part, determined by the environments in which it occurs, with the participants situated as the evaluators (Bronfenbrenner, 1979).

Participants and Recruitment

Nonprofit organizations and church communities identifying as those serving primarily KA populations in a large midwestern city were contacted as potential recruitment sites. Leaders shared information about the study with families who they believed met participation criteria. All parents who volunteered and identified as having at least one child with ASD with an Individual Education Program (IEP) were accepted into the study. The purpose of the study, addressing social skills through PRT intervention, was explained to each family. The PRT intervention was implemented in community settings twice per week over a period of three months. Families were interviewed before, during, and after the intervention in Korean, English, or a combination of their choosing. Additionally, five community members (e.g., a pastor, volunteers) who had regular interactions with the focal children were also invited to participate by completing a post-intervention questionnaire (Kim, 2017). All names are pseudonyms.

Ian Lee. Ian is a 6-year-old boy with ASD. His mother, Su-Na Park, and a 9-year-old typically developing sister, Mia Lee, participated in the interviews. His family moved to the US for his father’s advanced education when Mia was 2 years old. His father, Han-Su Lee is a pastor at a KA church, and his mother is a stay-at-home mom. Ian also has a typically developing 4-year-old sister. The parents speak predominantly Korean at home, but Mia speaks both Korean and English. Ian understands some words in Korean. Ms. Park does not speak English fluently and reported that she has struggled to learn it.

Ryan Ha. Ryan is an 8-year-old boy with ASD. His mother, Eu-Jin Hong, participated in the interviews. The family immigrated to the US from Korea about 12 years ago for both parents’ advanced education. A year after immigrating, Ryan’s older brother was diagnosed with ASD at age 3, so Ms. Hong withdrew from her master’s program and stayed at home to provide the brothers’ care and education. The family experienced financial problems when Mr. Ha remained in graduate school. The parents speak Korean at home, but Ryan’s brother mostly speaks and understands English. Ryan understands basic Korean, but speaks one or two words to initiate or respond to others in English.

David Cha. David is a 10-year-old boy with ASD. Both his mother and father participated in the interviews. His father, Young-Gi Cha, immigrated to the US more than 15 years ago for work after he finished high school in Korea. His mother, June Han, also moved to the US about 15 years ago to study photography. Mr. Cha is a janitorial supervisor at hotels. Ms. Han was a stay-at-home mom, but recently started a career as a full-time realtor. Both parents fluently speak Korean and English, choosing to communicate with each other in Korean. Mr. Cha usually speaks Korean when he communicates with their children, while Ms. Han speaks only English with them. David’s younger brother, a 6-year-old boy, understands and predominantly speaks English. David is also a verbal communicator and expresses himself using mostly phrases and short sentences in English.

Lucy Min. Lucy is a 9-year-old girl with ASD. Her mother, Mina Choi, and father, Dong-Hee Min, participated in the interviews, as did her 11-year-old typically developing brother, Lucas. Lucy also has a younger sister with Down Syndrome. Lucy’s parents moved to the US for her father’s advanced education over 13 years ago; she continues to work at the same university where he earned his doctor-
ate. Ms. Choi is a stay-at-home mom. At home, the parents communicate predominantly in Korean. However, when Ms. Choi talks with Lucy and her younger sister, she speaks only English.

**Data Collection and Analysis**

Interview data was the primary source of qualitative data for this study. The semi-structured interviews protocols were modeled after those by Gresham and Lopez (1996) and Kennedy (1994, 2005). The pre-intervention interview protocol questioned stakeholders’ perceptions of the intervention (goals, procedures) and expectations of the children’s behavior change. The second interview, conducted during the intervention, facilitated changes to the treatment based on stakeholders’ values and preferences (e.g., questions probed progress toward behavior change goals, suggestions for changing the intervention). The third interview, post-intervention, gathered participants’ retrospective views on the same topics, in addition to their perspectives on participating in the research in the community context. Interviews with juveniles were simplified.

Most interviews with adults were one hour in duration. The first author transcribed and translated interviews. A graduate student in special education, a native Korean speaker, reviewed translations for accuracy. Field notes and other documents (e.g., IEPs) were collected and reviewed to supplement each case (Yin, 2008). The interviews occurred in participants’ homes and community settings such as churches, indoor playgrounds, and a recreational center.

**Data analysis.** Collection, management, and analysis of data, including memos, occurred simultaneously and consistently with the use of qualitative data analysis software. The authors read and identified repeated themes across cases (Yin, 2008). The first author was primarily responsible for analysis, meeting regularly with the second author to discuss results. The first and second authors began by deductively analyzing data, cognizant of the social and ecological validity definitions and theories used. The two authors also inductively coded for the information that directly emerged from the data. Finally, a cross-case comparison was conducted. During the process, sequential analytic coding procedures were applied (Saldaña, 2009). In the first cycle, using descriptive, *in vivo*, magnitude, structural, emotional, and holistic coding, data were refined into meaningful segments and names were assigned to each segment (Saldaña, 2009). In the second cycle, pattern coding reduced initial codes created, producing broader categories with noted patterns, commonalities, differences, and explanations across various data sources (Miles et al., 2013; Saldaña, 2009).

**Promoting credibility.** To enhance the validity of results, the authors used several strategies. First, while implementing the intervention in community settings, the first author maintained a consistent presence in the field over a period of one year, building rapport and observing connections between the research questions and the context of participants’ lives (Creswell, 2007, p. 207). Second, both authors reflexively identified, questioned, and attempted to bracket biases (Creswell, 2007). Third, the first author conducted member-checking with participants (Creswell, 2007; Lincoln & Guba, 2007; Miles et al., 2013). Lastly, triangulation was performed across different types of data (i.e., transcripts, field notes, observation).

**Results**

The analysis resulted in four themes: (a) valued aspects of intervention, (b) comfort of procedural certainty, (c) reassurance of social successes, and (d) affirmation of the intervention’s reach.

**Valued Aspects of Intervention**

Throughout the intervention, participants discussed the fit of the intervention with the children’s needs and micro-ecologies (i.e., contexts), aligning with the starting point for behavioral interventions; goal setting with families. Across families, stakeholders articulated multiple goals for the intervention closely related to their purposes for participating in the research. Those purposes included enhancing their children’s social skills, establishing positive peer attitudes toward their children, and taking the opportunity to reflect on current parenting.
Learning interaction skills. All parents and siblings commonly indicated that their primary reason for being involved in the intervention and interviews was to help the child with ASD acquire social interaction skills with those outside of the family. For example, as Ms. Hong consistently noted that children with ASD are often isolated in many contexts due to their social skill challenges. Their children with ASD experienced rejection from peers due to “autistic behaviors” that, according to at least one participant, “look odd.” Parents hoped that, through the intervention, the children would have successful social experiences, interacting and playing with friends in socially accepted ways. No parents expressed concern that this approach was deficit in orientation, however, they also saw PRT as an opportunity to change peers’ attitudes.

Establishing positive attitudes among peers and others. When it comes to establishing friendship with typically developing peers, all four families thought that teaching skills to children with ASD alone would not be beneficial. They all acknowledged from previous experiences that teaching their children a new skill would require time. Consequently, they agreed that including typically developing children in the intervention would be more robust. Parents believed that efforts to train peers at a young age would foster positive perceptions of disabilities and individuals with disabilities based on successful interaction experiences. They believed this would be more meaningful than simply teaching children with ASD social skills. The parents valued the promotion of a “correct” way of interacting with diverse people with opportunities to practice in natural settings. Some parents also hoped that the intervention would influence other peers’ (both children and adults) perceptions of disabilities. The parents expressed that a major challenge caring for their children was their neighbors’ indifference, lack of awareness about disabilities, and negative perception of disabilities. Ms. Hong said,

If people’s [negative] thoughts about disabilities could be changed, our community could improve. Then, their thoughts about our kids would change too. They could help children with disabilities more.

Reflecting on parenting. Parents considered the intervention and interviews an important opportunity for reflecting on and gaining support for their parenting approaches. Parents from each family questioned themselves, and wanted to clarify with the researcher whether their current parenting was adequate to promote social skill development in their children with ASD. They reflected that their parenting was often restricted by several different factors, such as a lack of capital (i.e., financial resources, educational information, support from other family caregivers) and language differences between the parents and the larger, English-speaking community. Even when educational resources were available, they had questions about the developmental fit because they did not see themselves as “experts.” They wanted to learn how to effectively interact with their children with ASD. They considered the intervention to be a helpful opportunity because observing their children’s interactions with friends enabled them to acquire effective ways to interact at home. After the intervention, Ms. Hong said, “I have seen how other kids [the peers] learned the skills and efficiently initiated interactions with my kid. I can try the intervention rules at home.” Ms. Park also said that by observing the intervention, all family members learned one effective way of communication that they all could apply.

Comfort of Procedural Certainty

Throughout the interviews, parents and siblings provided their evaluations of intervention procedures. They consistently reflected a thorough understanding and positive view of PRT, and they highlighted additional factors that they considered important.

Peer mediations. Peer mediation was the most attractive feature of the intervention for the stakeholders, as parents hoped to see that children with ASD can experience “friendship.” For them, an intervention with peers was important for a variety of reasons. First, parents noticed that friends are sometimes much more powerful than parents in teaching a new skill or addressing a challenging behavior of their children with ASD. Ms. Han noted that, through PRT, her son’s peer partner expanded his understanding of how to inter-
act and make sense of David’s behaviors, an evidence of intervention benefits and success. Both of David’s parents reflected that their son had accumulated a history of social failures. Mr. Cha said,

He really did not know how to enter into play situations. He sometimes went to strangers and said ‘Who are you?’ He was just blunt. So he made friends, even those who know he has a disability, astonished and upset.

Upon seeing the intervention’s success, some parents suggested that peers’ sex and age were factors that contributed to peer-mediated interventions’ success. First, some parents thought that restricting the intervention to a single peer partner (thus limiting the range of possible interactions in regard to sex and gender expression) would not address their learning to play with children of the opposite sex or those with a differing gender expression and/or identities. For example, David played with his PRT peer, a same-aged girl. Mr. Cha was concerned that he would not learn “gender play,” that is, how to do “boy” play. Ms. Han also thought the peer’s sex was important, but for different reasons. She asserted her belief that female partners could lead the intervention and model social skills better. Ms. Hong shared a similar idea as Ms. Han; she explained that girls have more “compassion” and a stronger sense of responsibility than boys. She said, “In order to be more successful, girl partners are better. Girls care more about others. Girls are responsible for what they need to do.” Additionally, some parents believed that older peers could be more effective because they have stronger “authority and responsibility.”

Procedural adaptation. During the intervention period, parents did not provide additional suggestions or concerns about PRT procedures. When asked, they reported satisfaction and did not consider the intervention to be intrusive. Direct questioning about the cultural fit of PRT resulted in few responses and little interest in discussing the topic. Only Ms. Han expressed an opinion, stating that nationality or race would not alter the results of a social behavior intervention because she believed that many social behaviors such as greetings and other communications are universal, irrespective of the country or language of origin. She said that although “manners” can be slightly different, PRT did not violate the rules of communication because the embedded procedures were somewhat universal. Ms. Han said,

I think that social behaviors are not totally different in different cultures. Well, in the US, if you meet someone in the elevator, you usually say ‘hi’ while in Korea you don’t. But if in Korea, you do say ‘hi’ in that situation, the person would not ignore you. He would say ‘hi’ back to you, although he might think to himself that you are funny. That’s it. These days, people know everything via media, and Korea has become Westernized. About the different culture... I think people will accept it generally.

While acknowledging the difference, she also de-emphasized it by positioning David, her son, as American:

I think... nationalities or races don’t matter. There will be no difference when applying this intervention if it linguistically works. My kid was born in the United States. And he has learned the culture here. If the intervention works linguistically either in Korean or English [if it can be communicated effectively], it will work. American or Korean or Mexican, I don’t think the culture [nationality] is important to learning social skills with this intervention.

Benefits and limitations of the intervention. All of the parents identified procedural and instructional versatility as the most beneficial aspect of PRT. First, they noted that the procedures were simple, making it easy for peers and focus children to learn and follow the “play rules.” Additionally, some parents liked that it could be implemented in a variety of community settings. The parents were satisfied with progress they noted in their children’s social skill learning with the support of multiple key stakeholders, including the researchers, peers, and community partners. They thought that PRT led to a systematic continuity of learning across contexts. Ms. Park said, “Ian learns social skills through school programs with teachers mostly. That is
it. But if the learning experience can be aligned across contexts with friends, it would be really great. He can achieve consistency in and out of school.” Others agreed that school-based social skills learning is somehow limited, and that community settings have greater potential for natural social development with typically peers and diverse adults with fewer constraints.

As the formal intervention period of three months came to a close, parents repeatedly voiced a common concern that sustaining the acquired social skills would be challenging. All parents and community members worried that the study duration was not sufficient for ensuring the focus children’s behavior changes and the friendships with the trained peers. They worried that peers would not continue initiating interactions since their roles were no longer required.

Reassurance of Social Successes

Families articulated several changes in the children with ASD associated with PRT. Those perceived changes were mostly positive and aligned with quantitatively measured results (i.e., increased social interactions, increased child’s happiness, and increased interests in interactions and social play) documented in the intervention study (Kim, 2017). Beyond perceived positive changes, many discussed changes in family members’ attitudes.

Fostering motivation. Families in this study commonly identified the biggest change in their children’s behavior as increased motivation to interact with others. They highly valued that their children started to have interest in peer play. Ms. Park and Ms. Han expressed significant excitement about their children’s increased engagement, noting fewer instances of rejecting others’ interactions or play. Ms. Park stated, “He got much better. He did not reject others. For example, when friends approached him or asked him to play, he never said ‘no.’ He is willing to follow the peer’s lead, and wanted to mimic what his friends did.” Ms. Han said that David’s attitude toward others was affable during the intervention periods. She thought that he naturally started to see himself as part of the community. In her opinion, successful social experiences and other people’s increased interest in him led to motivated participation in the community program.

Overcoming hesitation to engage. Some parents described children’s interaction and initiations becoming more natural as time passed with the intervention. As successful interaction experiences accumulated, children expressed fewer inhibitions to interacting with others. Ms. Han shared:

I saw him nicely asking a friend near him to open the juice bottle. He said, ‘Can you open this for me?’ And the friend took it, opened it and gave it back to David. David said ‘thank you’ to the friend. Everything looked so natural.

After the intervention, some parents articulated that their children’s also initiated interactions with a broader range of people, including adults, peers and/or siblings. Ms. Choi observed,

If she [Lucy] saw friends playing she wanted to go to them and play with them. This cannot be purchased with money or forced by me, but can be achieved when she really wants it. I appreciate that she has developed. She has been motivated.

Transitioning to new communities. Like Lucy’s family, David’s family had just joined their church community shortly before the PRT intervention began. Thus, this setting was new, representing a transition, to them both. Previously, he experienced problems during transitions. Ms. Han shared, “You can’t imagine how hard it was for David to have a new teacher and new classroom every year.” Surprisingly and despite the parents’ concerns, Ms. Han expressed that participation in PRT at the church setting fell into place, easing the period of adjustment.

Affirmation of the Intervention’s Reach

The families articulated the reach of several changes across their children’s micro-ecologies during the three months of PRT. Parents valued the range of applicability of the intervention. They noticed its effects across settings and relationships, underscoring their confidence in their children’s development.
**Friendship.** The families thought that PRT strengthened friendships based on mutual interests with peers for the children with ASD. After the intervention, Mia, Ian’s sister, said, “It helped Ian by making him new friends, not by embarrassing him. He was shy when he had no friends; but now he has friends and he is really happy.” All families spoke about more genuine peer friendships. Parents placed high value on peers’ early exposure to naturalistic experiences and thought that PRT would help overcome negative thoughts about disabilities for children both with and without ASD. The families thought that the intervention was a good medium as an “icebreaker” between peers and focus children with ASD. Ms. Park articulated,

[The partner has] changed a lot. He really cares about Ian now and has a totally different routine. He usually ignored Ian, but now he greets Ian whenever he meets him. And he asked Ian to play with him, and made eye contact. Ian also really likes to be with him. He talks to Ian a lot. He is trying hard. Ian also cares about him.

**Familial boundaries.** During interviews, all mothers expressed concerns about their husbands’ low involvement with their children’s education, perceiving that the fathers maintained low expectations for the children’s development and education. The mothers attributed fathers’ negative perspectives to a history of school failures and slow developmental processes. Few opportunities to check fathers’ views were presented during observations, however, participating fathers occasionally and directly expressed low expectations for positive outcomes as a result of PRT implementation.

The mothers noted the challenges of the typically developing siblings to maintain positive relationships with their siblings with ASD. Some mothers noted that PRT provided support for the siblings. They attributed previous difficulty to the limited communication skills of the children with ASD. Siblings often reportedly fought or were unable to communicate with each other. Ms. Han and Ms. Park thought that siblings’ involvement in the intervention (i.e., watching interventions and participating in interviews) enabled them with opportunity to learn efficient ways to communicate and enhanced their roles in family cohesiveness. Ms. Park said,

The good thing about this experience was that Mia watched all of the sessions and sometimes participated. She did not know how to interact with Ian. She always had conflicts with her brother and yelled a lot. Then, with this intervention experience, I think she learned about what Ian really likes and how to talk with him. The intervention helped our family understand family relationships and basically helped the sister.

Mia also said after the intervention, “It is really easy to understand his emotions and what he is trying to say [now].”

**Relationship with community.** Before the intervention, all families said that they did not have enough social connections or assistance from neighbors or communities due to others’ limited interests and awareness of ASD. The mothers wanted to have a means to openly talk about and acknowledge their children’s disabilities in their community. As a community-based intervention, PRT provided an opportunity for other stakeholders to observe and learn about the children’s differences. Parents sensed an increased interest in special education intervention and disability. Focal parents reported receiving positive feedback from other adults, providing a segue into conversations about disability, noting that talking about disability and their children’s developmental needs was less uncomfortable. They found that others wanted to hear and learn more. Ms. Choi said, “I’ve talked to [the peer partner]’s mom. She said she wants to watch a session sometime. I talked about how the partner actively implemented the session and other mothers [around her] also laughed a lot and said ‘so cute.’” Parents highly valued the community members’ changed attitudes, believing that the opportunities created a fertile environment for development of children with ASD.

**Discussion**

The purpose of this study was to explore social and ecological validity of PRT through KA stakeholders’ perceptions. The overwhelmingly positive views of PRT, as well as some of
the criticisms, illuminate issues of the cultural responsiveness of the intervention. The parents of children with ASD were members of a relatively small community of Korean-speaking immigrants embedded in a large city where they are racial and ethnic minorities. Many had advanced postsecondary degrees with employment statuses indicative of middle class.

Cultural Responsiveness and Validity

The cultural responsiveness of any intervention, in this case PRT, is often addressed by examining the match between the underlying values and overt practices of schooling and those of families who receive that intervention. Judging the fit of an intervention can shed light on the extent to which it is culturally responsive, but doing so also requires an understanding of the community and context in which the cultural practice is situated (Gutiérrez & Rogoff, 2003). Ignoring the situated nature of culture can result in rigid and flawed generalizations that fail to take into account the sociocultural context of education (Arzubiaga et al., 2008; Harry, 1996; Ladson-Billings, 2004). Elaborating on what is meant by cultural responsiveness exposes key limitations to the match/mismatch strategy. Several key precepts about culture must be acknowledged. First, people’s cultural identities are dynamic and complex constellations of human experience and expression (Trainor & Bal, 2014). Second, institutions and practices, in addition to people, convey culture. Third, social, cultural, and historical contexts, informing and informed by geographies, languages, religion, politics, and other factors associated with groups, also drive human behavior such as teaching and learning (Trainor & Bal, 2014).

In this study, parents shared many experiences and contexts that contributed to their cultural identities, including parenting a child with ASD. They also shared Korean ethnicity and language, identities as Asians and as minorities in the larger, geographic context, status as bilinguals and immigrants; and, to some extent, their socioeconomic backgrounds including education and relative financial security. All were supportive of developing a practice for changing the behaviors and social interactions of their children with ASD. They were comfortable with intervening and did not avoid identifying what they considered to be deficits in their children’s social development. In three families, parents’ advanced education experiences afforded them a familiarity with the practice of conducting research, perhaps reflecting their own experiences seeking advanced degrees or as parents regularly exposed to ASD information. They understood the study’s design and the need, for example, to both adhere to implementation protocol and to provide suggestions for change, which was reflected in their active engagement. Parents in this study voiced a desire to help their children conform to the social rules and expectations that guide interactions between children without ASD. They valued the rules that governed PRT implementation and had a desire for its implementation to be prescriptive and effective, indicating a potential match between the study’s sample and the intervention.

Learning from instances of cultural congruency between family (e.g., home) and intervention (e.g., school contexts) can be challenging. On one hand, it is important to understand the likelihood of acceptance by cultural practices such as PRT, and to ascertain the extent to which these will be supported and understood by families. Implementing interventions without considering beliefs and values about practices would advance a culturally-neutral approach to education. Culturally-neutral approaches have been widely critiqued as ineffective at best, lacking social validity for sustained implementation and/or discouraging the participation of some key stakeholders who might be considered, by themselves or others, as outsiders to a specific practice or context (Arzubiaga et al., 2008; Gutiérrez & Rogoff, 2003).

Beyond the examination of whether PRT was a match for these families, this study also illuminates the potential importance of having researchers/interventionists who share cultural identities and life experiences with participants. Perhaps shared cultural and linguistic backgrounds between the researcher (the first author) and the parents increased trust and rapport, easing implementation. On the other hand, similarities between practices and people are anything but straightforward;
what seems like a match in preference might also reflect, for example, embedded privilege and power. All four families in this study had the economic stability to support stay-at-home mothers available to organize the delivery of the intervention with the first author, showing up to the community center and making the home available for researchers, peer tutors, and their parents. Moreover, none of the immigrant parents in this study expressed concerns or fears associated with citizenship documentation, potentially contributing to their choice to be actively involved in this research. When probed, parents dismissed the need to devote attention to any cultural aspects of implementing PRT. This is relevant because social validity is concerned with participants’ acceptance of procedures, feasibility with the limits of available resources, efficacy, and continued use of the interventions (Horner et al., 2005).

Understanding Social and Ecological Validity in a Diverse World

The word diversity is often misunderstood and misused to refer to people of color or people from historical minority groups. Diversity is better understood as a characteristic of the larger U.S. society and many education micro-contexts. Diversity is a barometer of both the ideal of cultural pluralism and the reality of dominance/minority continua that are foundational to the U.S. What is socially valid to one group, or to individuals within a group, may not be socially valid to members of other groups or even individuals within the same group. Similarly, the ecological validity of the context of an intervention also varies. Parents in this study supported PRT in their everyday settings, however, this introduces question about its implementation at school. In the culture of practice of experimentation, of which single-case research is a part, this variation is an affront to generalizability.

Diversity within groups and across contexts can be understood by exploring the concept of intersectionality in cultural identity and life experience (Crenshaw, 1991; García & Ortiz, 2013), affording an analytic tool both for interpreting heterogeneity within a group of people who share common experiences or characteristics, in addition to understanding commonalities across groups of people from seemingly different backgrounds. Specifically, intersectionality “makes possible the examination of the simultaneous interactions among race, class, gender, and disability for any individual child, family and community, as well as the interplay between these individual or group characteristics and organizational responses to them” (Garcia & Ortiz, 2013, p. 34). In this study, for example, one family struggled financially and another was led by parents without advanced degrees. This understanding could be used as a lens through which to filter varied perspectives about the ways an intervention is deemed socially as well as ecologically valid within the contexts of practice. For example, a family’s financial struggle might limit the time for PRT implementation, and thus introduce limited contexts for implementation.

Second, sociocultural lenses prioritize the contextualization of data throughout the research project, at recruitment, collection, interpretation, and dissemination (Bronfenbrenner, 2005). The first author designed the study, hypothesizing that her presence would increase the inclination of members of this minority group to actively participate in this project because they shared a common language, as well as some immigration and education experiences. During the collection of data, the first author added memos to the project detailing how her interactions with participants related to her interpretation of data, and in analysis, she generated additional memos noting the logic of decision-making as themes emerged (Corbin & Strauss, 2008). These efforts align with criteria for rigor associated with qualitative designs (Trainor & Graue, 2014). Throughout the qualitative study, the authors detail the contextual variables related to community participation that contributed to the social validity of PRT for this group.

There are many notable, specific characteristics of the PRT intervention upon which the group agreed. In the examination of social and ecological validity of PRT, the data demonstrate that the families were comfortable with, supportive of, and participatory in the intervention. We also learned that families prioritized friendship development, the implementation of the intervention in natural set-
tings, and the change in attitudes of peers, siblings, and themselves. The intervention was ecologically valid because the contexts supported the natural observation opportunities of the intervention. From the process of goal setting to the evaluation of outcomes and the importance of the intervention’s results, families gave equal weight to teaching new behaviors to their children and changing others’ perspectives of their children’s development. Parents thought that these changes in others were meaningful because they helped to develop positive relationships within the boundary of community membership, and these changes supported their parenting experience. Changing attitudes have been documented among Koreans’ and KAs’ traditionally negative thoughts about disabilities, but these sometimes work as a barrier for parenting and children’s development within the community (Cho et al., 2000).

Subtle instances of diverse perspectives were noted, yet they did not negate from the social or ecological validity of the intervention. As previous researchers have asserted, parents in this study also generally appreciated that the attention of peers and the community would provide positive and ample stimuli creating a fertile environment in which the children with ASD will regularly interact and develop (Koegel et al., 2005). Social skills development for children with ASD has been traditionally studied in school contexts (Koegel et al., 2005). The results of this study suggest that the field of special education needs to develop strategies in various community settings such as religious group settings, play dates, and recreational or extracurricular programs, and to study and disseminate social skill interventions in these settings (Koegel et al., 2005; McConnell, 2002; Rogers, 2000).

Some parents’ interests in the relationship between children’s sex, age, and gender identity development could be interpreted as cultural. Farver and Lee-Shin (2000) asserted that social relationships between Korean individuals are based on a hierarchy, reflecting their gender, age, and role. Further, Park and Cho (1995) posited that the use of language and choice of behaviors reflects their cultural and social status (e.g., a person of lower status uses honorifics to a higher status person). Such cultural factors might affect the intervention goals, parents’ and children’s choices of play materials and themes, as well as the intervention results and outcomes.

Some of the participants’ views could be interpreted as inter-group variation in that they may differ from dominant-group perspectives. For example, parents’ desire for children to follow what could be described as the cultural norms of the larger group was expressed in some parents’ comments about sex and gender expression or identity and PRT peers. Exploring this more fully with participants is a consideration for further research. Additionally, several barriers with regard to future benefits of the intervention were identified by parents; they were concerned about the sustainability of PRT without an expert or interventionist. Nevertheless, positive results are well-aligned with the results of PRT intervention research (Kim, 2017) and support previous PRT research (e.g., Harper et al., 2008; Koegel et al., 2005).

Overall, we found that KA stakeholders have particular values and beliefs shared to some degree by their cultural group (Banks, 2006). More importantly, we also found that these shared values and experiences are perceived and experienced slightly differently by group members (Banks, 2006). Consequently, the results imply that designing culturally responsive interventions essentially begins with considering both the experiences and perceptions of the individuals in the micro-cultural group, the context and the culture of practice, and acknowledging the observed variation. Consideration of the ways in which other factors such as race, language, gender, community, sexual identity, and social class interact together to influence individuals’ experiences and their responses to those experiences is vital (Banks et al., 2005). Knowing the overarching values and perceptions is important and helpful for researchers, but there must be a specific effort to avoid stereotypical assumptions.

Using various data sources, case study researchers can explore a phenomenon in a bounded context, generally leading to a rigorous qualitative case study (Baxter & Jack, 2008). This study’s limitations, however, are important to acknowledge. Given the commonalities across cases of self-selecting par-
Participants variation was narrow. To offset the limitation, within the data, we tried to alertly ensure the validity of the data and analysis by using several strategies, such as member-checking, consistent engagement and observation (Creswell, 2007), and data triangulation (i.e., interviews, field notes, and questionnaire). Another limitation is related to the interviewer as an authority figure. As the first author conducted the interventions for the children with ASD and interviews with families, the author’s role might have brought a potential power difference that possibly influenced the respondents of this qualitative study.

**Implications for Practice and Research**

Families indicate that there were changes in the focus children’s micro- and meso-systems over the three months of intervention. Stakeholders described in depth how the children with ASD, their families, and the larger community changed their interactions with one another. Parents reported that community’s and neighbors’ positive perceptions, resulting from the intervention, would facilitate their family’s community participation. These promising findings may suggest that practitioners can consider and use naturalistic approach and peer-mediation elements for social skill training in many other important ecological contexts, including schools.

Social validity has been considered an important element of single case research (Horner et al., 2005), but has not often been included in social skill intervention research (Machalicek et al., 2008). Incorporating the investigation of social validity in intervention research is necessary as its measurement can address the evaluation of the significance of the intervention and children’s behavior changes. As the current study reveals, qualitative inquiry into social validity allowed us to explore the cultural responsiveness of the PRT intervention with four KA children with ASD and their families. Specifically, for this novel population of intervention participants, we were able to gain a more complete understanding of participants’ values and perceptions of the intervention, while examining its statistical effect. These ongoing interactions between the two research methods (quantitative and qualitative) supported and informed each other’s data collection procedures and outcomes (Creswell & Clark, 2010). Future research might investigate the validity and acceptability of interventions, using diverse and flexible methodologies to answer various research questions.

In sum, the procedures and results of the current study might provide a preliminary resource to many ASD researchers investigating the importance of contextual and cultural responsiveness of EBIs among CLD participants with ASD. The current study has sought to see to what extent an intervention could be more socially valid and culturally responsive. In particular, the qualitative investigation extended the existing realm of studying social and ecological validity to reflect stakeholders’ values and perceptions on intervention goals and procedures throughout the different stages of intervention. The positive results of the intervention (Kim, 2017) were supported by stakeholders’ evaluations and interpretations of the outcomes. This indicates the importance of understanding the values of participant and stakeholder through consistent cooperation to design a culturally responsive intervention.

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Comparing the Effects of Echoic Prompts and Echoic Plus Picture Prompts on Establishing Intraverbal Behavior for Children with Autism

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Abstract: The purpose of this study was to compare the efficiency of two prompt strategies (echoic versus echoic + picture) on establishing the intraverbal behavior (i.e., question answering) for three 4-year-old children with ASD in China. All three children had mand, tact, and echoic behavior in their repertoire, but had a limited intraverbal repertoire. An adapted alternating treatments design combined with a multiple probe across two behaviors (two question sets) was used. Results indicated that both strategies were effective to teach and maintain question answering for all three children. However, the echoic prompt strategy required fewer trials to criterion than the echoic plus picture strategy, suggesting the efficiency of echoic prompts to establish intraverbal repertoire for these children.

Autism spectrum disorder (ASD) is comprised of core deficits in social communication and restricted interests or repetitive patterns of behavior (American Psychiatric Association, 2013). Many children with ASD do not have adequate communication skills, lack appropriate interactions with others, and do not initiate conversations or respond to other people’s questions. Therefore, communication is one of the most important target areas in early intervention for children with ASD (National Research Council, 2001).

Intraverbal behavior is one type of elementary verbal operant defined as a verbal response evoked by a preceding verbal stimulus without point-to-point correspondence (Skinner, 1957). Some examples of intraverbal behavior include word associations or fill-in-the-blanks (e.g., saying “Go” upon hearing “Ready-set”), rote count (e.g., 1-2-3-4-5...), singing songs, or answering questions (e.g., saying “Good” when hearing “How are you?”). Intraverbal training is recommended as one of the focuses in early language training programs for children with ASD or other developmental delays (Sundberg & Partington, 1998).

Previous research in the behavioral literature suggests that several prompt strategies are effective to establish intraverbal behavior for children with ASD or developmental delays, including echoic prompts (Ingvarsson & Le, 2011), picture prompts (Goldsmith et al., 2007; Ingvarsson & Hollobaugh, 2011), and textual prompts (Vedora et al., 2009). Research in teaching the intraverbal with various prompts indicates that multiple sources of control are involved in the intraverbal relations (Michael et al., 2011). Besides understanding the intraverbal relations, finding a prompt strategy that is most effective and efficient to establish intraverbal for children with ASD is important for practitioners working in applied settings. Therefore, it is impor-
tant to conduct studies that compare different types of prompt strategies commonly used in teaching intraverbal in order to answer this practical question (Ingvarsson & Hollobaugh, 2011; Ingvarsson & Le, 2011). Although previous research has indicated that these types of prompts were effective for establishing intraverbal behavior for children with ASD or developmental delays, comparisons of the efficiency of different types of prompts to teach intraverbals yielded mixed results. Researchers found that textual prompts (Finkel & Williams, 2001; Vedora et al., 2009), picture prompts (Ingvarsson & Hollobaugh, 2011), or echoic prompts plus modeling (Valentino et al., 2012) were more efficient than echoic prompts. It is possible that visual prompts (textual or picture) contained the longer duration of exposure during instruction (Finkel & Williams, 2001; Vedora et al., 2009) or are more likely to evoke visual imagining that facilitates faster acquisition (Ingvarsson & Hollobaugh, 2011). In Valentino et al. (2012), the target intraverbal responses were in the form of sign language, which may necessitate visual cues such as modeling in the acquisition process.

By contrast, researchers also found that echoic prompts were more efficient than picture prompts (Ingvarsson & Le, 2011; Kodak et al., 2012). One potential explanation, based on the demonstration in Coon and Miguel (2012), is that the children may have a history of effective learning via echoic prompts, rendering echoic prompts more efficient (Ingvarsson & Le, 2011). Kodak et al. (2012) attributed the efficiency of echoic prompts to the relatively frequent contact with echoic prompts in the error correction procedure.

Similarly, Vedora and Conant (2015) found inconsistent results among three adult participants in their study: one acquired the intraverbal equally with echoic or picture prompts, one acquired faster with echoic prompts, and one with textual prompts. The researchers attributed the results to the participants’ individual preferences in learning the intraverbal with regards to their relative strengths in their repertoire. Although the reported efficiency of prompt strategies varies across studies, researchers generally suggest that efficiency for each prompt strategy may be related to participant characteristics (e.g., their strengths and weaknesses), the history of exposure to or effective learning via certain prompt strategies, and the procedural differences in each prompt strategy that may facilitate faster acquisition of the intraverbal. When conducting comparative studies, it is important to obtain adequate control of these factors by selecting participants with similar characteristics and learning backgrounds as well as minimizing procedural differences between prompt strategies in comparison.

As stated previously, comparing different prompt strategies in the acquisition of the intraverbal will enhance our understanding of the controlling variables in the intraverbal relations and provide a practical answer to practitioners working in applied settings (Ingvarsson & Hollobaugh, 2011; Ingvarsson & Le, 2011). The efficiency of intervention for children with ASD and developmental disabilities is especially pressing in a low-resource setting such as China. With high demands of services and limited number of professionals, only few children with ASD and developmental disabilities are able to receive intervention services in China (Sun et al., 2013). When they do receive the services, the cost is high and the hours allocated for each child are usually low. Therefore, cost-efficiency is a particularly important issue for practitioners providing intervention services in China.

In response to the knowledge gap in intraverbal instruction and practical needs for cost-efficient intervention in China, the purpose of this study was to compare two different prompt strategies commonly used to teach the intraverbal for children with ASD: the echoic prompts and the echoic plus picture prompts. Given the mixed results from previous comparative studies, we did not compare echoic and picture prompts; instead, we compared echoic prompts with and without the addition of picture prompts. Additionally, we selected children who had never received behavioral instruction, had a strong echoic repertoire, could tact at least 30 common items, but had no or limited intraverbal behavior prior to the study. Specifically, we compared two prompt strategies in terms of (a) the percentage of accuracy of intraverbal responses during probe sessions across the baseline, instruction, and maintenance conditions, and (b) the total
number of trials required to achieve criterion, for three young children with ASD in China.

Method

Participants

Three 4-year-old boys diagnosed with ASD participated in this study. They were referred to this study by their teacher or parents for lack of interactive language communication. All three participants attended regular preschools for half day in the morning. Yi attended 1-hr music therapy in the afternoon five days per week. He was diagnosed with ASD with the Chinese version of Psychoeducation Profile-Third edition (PEP-3; Heep Hong Society, 2009; Schopler et al., 2005), the Chinese version of the Childhood Autism Rating Scale (CARS; Li, Zhong et al., 2005; Lu et al., 2004; Schopler et al., 2002), and met the criteria of ASD in the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5; American Psychiatric Association, 2013). The PEP-3 indicated that his developmental age was between 9 to 11.3 months with severe delays in communication and emotion. His CARS score was 38 in the category of severe autism. He could mand spontaneously for 10 items only when preferred items were present but could mand without seeing the items when provided verbal prompts, “What do you want?” He could tact more than 30 common items presented in the pictorial form and followed one-step directions. His echoic included any single word, any two or three-word phrases, and up to five-word full sentences. He did not have intraverbals and would repeat the last two words when asked WH questions. Yi was often observed to repeat phrases or sentences heard previously and make humming sounds repeatedly.

Xi received play therapy in the afternoon for 2 hrs. per day, four days per week. He was diagnosed with ASD by a pediatrician using CARS and DSM-5 criteria. His IQ was 87, measured by Wechsler Preschool and Primary Scale of Intelligence-Revised (WIPPSI-R; Wechsler, 1989; Zhang, 2009). When prompted with “What do you want,” he could mand at least 10 items with full sentences (i.e., I want __). He usually would retrieve preferred items by himself without manding if verbal prompted were not provided. He could tact more than 30 common items presented in pictures. He was able to echo any single words and two to three-word phrases. Xi did not have intraverbals and did not answer social questions. He sometimes repeated words or phrases heard.

Ming received the floor time therapy in the afternoon for 1 hr. per day, five days per week. His developmental age measured by PEP-3 was between 33 to 35 months with a mild delay in communication and a moderate delay in emotion. He was diagnosed with ASD based on the CARS score (36.5, severe autism), PEP-3, and DSM-5 criteria. Ming followed at least 10 two-step directions. He could mand independently for at least 10 items only when preferred items were within his eyeshight. He could tact more than 30 common items. He had a strong echoic repertoire and could imitate full sentences. He could answer two social questions (i.e., his name and age) and continue children’s songs intraverbally. He did not display echolalia.

Setting and Materials

The study took place in a university-affiliated autism center of a major city in central China. The instruction was delivered in Mandarin. All sessions were conducted in an individual therapy room (about 2.5m by 2.5m, and 3m from floor to ceiling). The therapy room included one child-sized table with two chairs, a play area with toys and books on the shelves, a video camera for recording sessions, and a two-way mirror window for observations from outside. All sessions were conducted in a one-on-one format at the table in the room.

Picture cards were used in this study. Each picture card contained one picture of a target object without words in a 7x10 cm index card. The color pictures were selected from various websites via the internet. See Table 1 for questions used in this study.

Experimental Design

This study used an adapted alternating treatments design (Wolery et al., 2014) to compare the efficiency of two instructional strategies (echoic only versus echoic + picture) on the acquisition of intraverbals. A multiple probe across two sets of intraverbals was used to evaluate an additional set of intraverbal within each participant. After a stable base-
line was established for each set, the intraverbal training was introduced to set 1 and set 2 until reaching the criterion of 100% across two consecutive sessions. Questions in set 1 were taught with echoic prompts, while questions in set 2 were taught with echoic plus picture prompts. Next, the intraverbal training started with set 3 using echoic prompts and set 4 using echoic plus picture prompts. Two sessions were conducted with each child using two question sets with two prompt procedures with a 30-min break between sessions.

The difficulty level was equal between the sets of intraverbals used for either strategy as suggested in Wolery et al. (2014): a) some of the intraverbals were selected from a list of mastered intraverbals with a similar number of trials to criterion from a child in the autism center, b) the other intraverbals were selected from a list of known items for typically-developing 3-year old Chinese children (Chi, 2002; Yu & Jin, 2013), c) all intraverbal questions and answers taught with either strategy were matched to the same number of Chinese words (each Chinese word only contains one syllable and no consonant at the end), and d) the names of the items as answers were all in each child’s tact repertoire.

Response Definitions and Data Collection

The dependent variables of this study included the percentage of accurate responses during probe sessions across conditions and the number of trials to criterion during intraverbal training for each set of questions. The percentage of accurate responses for each set was calculated by dividing the number of questions answered correctly by 5 (the total number of questions in each set) and multiplying 100. A correct response was defined as: upon hearing the question, the child independently provided an answer that matched the answer to the question listed in the data collection sheet. If an answer did not match the answer or no response was given, it is counted as an incorrect response. The experimenter used data collection sheets containing questions listed in order, prompt procedures used for the questions, the answers for each question, and space to record student responses. Every correct student response was recorded as a “+,” and every incorrect response was recorded as a “−.” Data collection was conducted via the paper-and-pencil format. The percentage of accuracy during probe sessions was graphed in the figures.

The number of trials to criterion was determined by the total trials required for each set.
of intraverbals to reach criterion performance during intraverbal training. The mastery criterion was 100% accuracy of all five questions in a set for two consecutive probe sessions conducted by the experimenter and one probe session conducted by another instructor. The instructors used the same data collection sheets to record student responses during training.

Procedure

Preference assessment. Prior to the study, parents were asked to provide a list of their children's preferred items. A multiple stimulus without replacement preference assessment (Leon & Iwata, 1996) was conducted to determine seven highly preferred items. Prior to each session, the instructor presented available preferred items and allowed the child to choose preferred items for that session.

Baseline. During baseline, the experimenter asked each question and waited 3 s for the child to respond. If the child responded correctly within 3 s, the experimenter provided praise for each correct response along with a reinforcer specified by the child. If the child responded incorrectly or had no response, the experimenter ignored any incorrect or no response but praised the child’s attending behavior in order to maintain participation. The generalization probe sessions were conducted by other instructors. The instructors asked the children the same questions, praised for correct responses, and ignored incorrect responses.

Intraverbal training. Under this condition, a probe session was conducted each day prior to the beginning of intraverbal training sessions. The experimenter conducted one probe trial for each question during the probe session in the same manner as baseline. The generalization probe sessions were conducted by other instructors.

The intraverbal training sessions began after the completion of the probe session. For set 1 and set 2, one training session began with set 1 questions using echoic prompts followed by another session with set 2 questions using echoic plus picture prompts. Each question had three trial opportunities with a pre-determined prompt strategy to evoke the correct response. The three trials were implemented consecutively without breaks. The pre-determined prompt strategy was provided immediately following the delivery of each question. With five questions in each set, one training session contained a total of 15 trial opportunities. For each trial, the child was provided with praise when he responded correctly following the prompt. The instructor then delivered the next trial by asking a question. If he did not respond correctly following the prompt or did not respond within 5 sec, the instructor provided an encouraging statement (e.g., “Nice try,” or “Good listening,”) while implementing an error correction procedure. For questions taught with echoic prompts, the instructor provided an echoic, (e.g., “Toothbrush”) for the child to repeat the correct response during the error correction. The error correction procedure for questions taught with echoic plus picture prompts involved an echoic and the presentation of a picture for the child to repeat the correct response. Each training session ended with providing the child with a reinforcer specified in the beginning of the session. Each training session took approximately 3 to 5 min to complete.

When questions in set 1 and set 2 reached 100% accuracy, another instructor conduct a probe session to test generalization of acquired intraverbals to an unfamiliar person. If the child reached 100% in one generalization probe, the training was complete, and the intraverbal training was introduced to set 3 and set 4, starting with set 4 using echoic plus picture prompts and set 3 using echoic prompts.

Maintenance. Maintenance of acquired intraverbals was evaluated 3 weeks and 6 weeks following the completion of the intraverbal training for each child. Maintenance probes were conducted in the same manner as baseline and probe sessions under the intervention condition.

Treatment Fidelity and Interobserver Agreement

All sessions were videotaped for the purposes of assessing treatment fidelity and interobserver agreement (IOA). A graduate student in special education, who was naïve to the purpose of this study, served as a second observer. The second observer was trained to observe the instructor’s implementation of
the intraverbal training procedures based on the checklist (Table 2) and record children’s responses during probe sessions from the videotapes using the data collection sheet until at least 90% accuracy was reached for two consecutive sessions. Then the observer recorded treatment fidelity and IOA independently and separately from the experimenters. The data of treatment fidelity were assessed in 56.7% of the total intraverbal training sessions, and IOA on target behaviors were collected for 24% of the total probe sessions evenly distributed across conditions for each child.

To assess treatment fidelity, the observer used the checklist (Table 2) to record an accurate and inaccurate implementation for each step in a block of three trials for each question during intraverbal training. Each accurate implementation was checked under Y, while an inaccurate implementation or omission was checked under N. The percentage of fidelity was calculated by dividing the number of checks on Y by the number of checks on Y plus checks on N and multiplying by 100. Data of treatment fidelity were 95.03% for all sessions observed. IOA data were assessed point by point by comparing two observers’ recordings on child responses. When any disagreement occurred, both observers watched the videotapes together to ensure data were recorded accurately. As a result, the agreement was 100% for all sessions observed.

Results
Figures 1 to 3 depict the percentage of correct responses for questions taught with both prompting procedures during probe sessions for Yi, Xi, and Ming, respectively. During baseline, Yi did not provide any answers to the questions. When the intraverbal training was introduced, the accurate responses provided during probe sessions increased to relatively high levels for questions taught with echoic prompts (80% for set 1 and set 3), and echoic plus picture prompts (60% for set 2; 20% for set 4). Correct responses to questions taught with both prompt procedures displayed a gradual ascending trend and reached mastery. The accurate responses were maintained at 100% accuracy during 3-week and 6-week maintenance probe sessions for questions taught with either prompting procedure.

Xi did not provide any answers during baseline for set 1 and set 2, but reliably provided an accurate response to one of the questions in set 3 and set 4. His accurate responses increased during second probe sessions, ascended to high levels, and reached mastery criterion for questions taught with either prompting procedure. He also maintained 100% accuracy for all questions acquired 3 and 6 weeks after the completion of the intraverbal training.

Ming’s data also displayed a similar pattern as Yi and Xi. He did not provide any answers during baseline. His accurate responses to questions taught with either prompting procedure gradually increased and ascended to 100% accuracy during intraverbal training and maintained at the same level during maintenance.

Figure 4 displays the number of total trials to criterion for questions sets taught with echoic prompts and echoic plus picture prompts for the three children. For Yi, questions taught with echoic plus picture prompts (30 trials in set 2; 30 trials in set 4) required nine more trials to

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**TABLE 2**

Treatment Integrity Checklist Used for Each Block of Three Trials for Each Question During Intraverbal Training

<table>
<thead>
<tr>
<th>Preparation</th>
<th>Getting Materials and Equipment Ready for Sessions</th>
<th>Y □ N □</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>Reinfocer assessment</td>
<td>Y □ N □</td>
</tr>
<tr>
<td>Treatment</td>
<td>Obtaining child’s attention</td>
<td>Y □ N □</td>
</tr>
<tr>
<td>Treatment</td>
<td>Accurate SD (an intraverbal question)</td>
<td>Y □ N □</td>
</tr>
<tr>
<td>Treatment</td>
<td>Accurate prompt (echoic or echoic + picture)</td>
<td>Y □ N □</td>
</tr>
<tr>
<td>Treatment</td>
<td>Reinforcing a correct response</td>
<td>Y □ N □</td>
</tr>
<tr>
<td>Treatment</td>
<td>Providing an error correction for an incorrect response</td>
<td>Y □ N □</td>
</tr>
</tbody>
</table>
criterion than questions taught with echoic prompts (21 trials in set 1; 21 trials in set 3). Xi also required more trials to criterion for questions taught with echoic plus picture prompts (30 trials in set 2; 24 trials in set 4) than with echoic prompts (21 trials in set 1; 21 trials in set 3). Ming reached criterion performance for sets 1 and 2 with the same number of trials to criterion (48 trials for each set), but reached criterion faster for questions taught with echoic prompts (24 trials for set 3) than with echoic plus picture prompts (51 trials for set 4). Overall, all three children achieved the mastery criterion requiring more number of trials for questions taught with echoic plus picture prompts than with echoic prompts.

**Discussion**

The purpose of this study was to compare the efficiency of two prompt strategies (echoic versus echoic plus picture) on establishing the intraverbal behavior (i.e., question answering) for three young children with ASD in China. Results indicated that both strategies were effective to teach and maintain question answering for all three children. However, the echoic prompt strategy required fewer trials to criterion than the echoic plus picture strategy, suggesting the efficiency of echoic prompts to establish intraverbal repertoire for the three children with a strong echoic repertoire.

Both strategies effectively established intraverbal behavior for all three children, as the acquired intraverbal responses for the questions achieved high levels of accuracy and maintained up to 6 weeks after the completion of the instruction. High levels of accuracy in the generalization probes across different instructors also indicated that the established intraverbal behavior was under the control of
the preceding verbal stimuli but not any other irrelevant stimuli in the environment.

Previous studies comparing echoic and picture prompts had inconsistent results with the same procedure (Ingvarsson & Hollobaugh, 2011; Ingvarsson & Le, 2011). The researchers suggested that the potential explanation for the differences may be attributed to the different instructional histories of the participants in two studies. Ingvarsson and Hollobaugh (2011) identified that three participants had acquired the intraverbal behavior of question answering more efficiently with picture prompts. These children received special education services with no fully known instructional histories. However, their existing skills prior to their study were not clearly reported. Ingvarsson and Le (2011) found four children had learned intraverbal question answering faster with echoic prompts than with picture prompts. These children received early intensive behavioral intervention and had experiences in various types of prompt strategies in their histories. One of the four children had rote counting and the other three children had question answering and fill-in-the-blank intraverbal behaviors in their repertoires prior to the beginning of their study. Two of the children displayed immediate echolalia. It is possible that the children had established preliminary intraverbal behavior and echoic prompts efficiently extended their intraverbal behavior to answering other types of questions.

By contrast, children in this current study never received any intervention with systematic and consistent prompt strategies. Results of the pre-experimental assessments indicated that they all had a strong echoic repertoire

![Figure 2. Percentage of correct independent responses across conditions during probe sessions for Xi.](image-url)
One child had no intraverbal behavior, and the other two children had limited and unreliable intraverbal behaviors (i.e., completing children’s songs and answering his name). Our finding indicated that our children learn faster with echoic prompts alone. It is possible that children with weak or no intraverbal behavior, but with a strong echoic repertoire, are more likely to learn the intraverbal faster with echoic prompts alone. It is possible that children with weak or no intraverbal behavior, but with a strong echoic repertoire, are more likely to learn the intraverbal faster with echoic prompts alone. It is possible that children with weak or no intraverbal behavior, but with a strong echoic repertoire, are more likely to learn the intraverbal faster with echoic prompts alone. It is possible that children with weak or no intraverbal behavior, but with a strong echoic repertoire, are more likely to learn the intraverbal faster with echoic prompts alone. 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speculate that such an association exists in the initial acquisition process of the intraverbal through the presentation of the echoic prompts. For example, the question-answer association was initially acquired as one unit with an echoic prompt (e.g., “What do you drink with? A cup”) to evoke a verbal response (e.g., “A cup”). Later when the echoic prompt was removed from the question, the child emits the answer as an intraverbal response via the association. Acquiring associated words as one unit in intraverbal relations is commonly observed in young children engaging in rote recitations of poems and songs. Filling-in-the-blanks or completing sentences is also recommended as one of the initial intraverbal programs for young children with language delays (Sundberg & Partington, 1998). By contrast, the addition of a non-verbal stimulus, a picture, requires the child to look at the picture for a tact response to occur. The association between question-answer as one unit may be disconnected with the presentation of the visual stimulus due to the functional independence between tact and intraverbal. Therefore, more practice opportunities are required for the transfer from tact to intraverbal to occur. However, there is no empirical support for the above speculations. More research is needed to examine the behavioral processes involved in the acquisition of transfer of stimulus control in intraverbal relations.

Despite the notable differences between echoic and picture prompts in the acquisition of intraverbal, we did not compare two distinctly different prompt strategies. Both strategies included echoic prompts with or without the addition of picture prompts. Valentino et al. (2012) reported the efficiency of echoic plus modeled prompts to establish the intraverbal, compared to echoic prompts only. However, the target intraverbal behavior was in the form of sign language in their study. It is possible that the intraverbal using sign language is acquired more efficiently with the addition of visual models due to the fact that sign language is multiply controlled by preceding a verbal stimulus accompanied with a non-vocal stimulus of signs. The faster acquisition of the intraverbal with the addition of modeled prompts is possibly related to the topographical similarity between the prompt strategy (e.g., a modeled prompt) and the target intraverbal response (e.g., a sign). Similar to our study, faster acquisition of the intraverbal was resulted from the prompt strategy (i.e., echoic) involving the same topography as the target intraverbal responses (i.e., vocal). Again, further investigations are necessary to clarify this issue.

Another possible attribute for differences in the acquisition of the intraverbal is related to procedural differences among studies. In the present study, we implemented immediate prompts without time delay, the echoic

Figure 4. Number of trials to criterion for question sets taught with echoic prompts versus echoic plus picture prompts for all three children.
prompts included only the target response, and the error correction procedure required the child to emit the target response without re-presenting the antecedent. Other studies may include instructive word, “Say __,” in an echoic prompt for the target response (Finkel & Williams, 2001; Ingvarsson & Hollobaugh, 2011; Ingvarsson & Le, 2011), repeated presentations of correction trials (Kodak et al., 2012), and gradual prompt fading procedures involving increased time delays (Kodak et al., 2012) or fading one word at a time (Finkel & Williams, 2001). The procedural differences pertaining to controlling variables in intraverbal relations may affect learning outcomes as children with ASD and developmental delays are sensitive to subtle differences in procedures.

Previous studies indicate that textual prompts are more efficient in increasing intraverbal behavior in children who had sign-word reading skills (Finkel & Williams, 2001; Vedora et al., 2009). Although the children in our study did not have textual behavior in their repertoire, it would be interesting to conduct a follow-up study comparing the efficiency among different types of prompt strategies to increase the intraverbal behavior once these children acquire textual responses.

Results of this study did not confirm the notion that repeated exposure to a particular type of prompts increased the efficiency of skill acquisition with that type of prompts (Coon & Miguel, 2012). The total number of trials to criterion for the second questions sets did not decrease as a result of previous exposure in each type of prompts. It is possible that the exposure in the first question sets was not sufficient to reduce the required trial trials to achieve criterion in the second question sets.

Limitations of this study include the lack of comparison between echoic prompts and picture prompts only, as well as the relatively short exposure for each type of prompt strategy. Future researchers can consider adding a third condition with picture prompts only to compare the differences in the acquisition of the intraverbal behavior. It is also possible to add another one or two question sets to prolong the exposure to each type of prompt strategy and observe the change in the acquisition processes.

In sum, both prompt strategies used in this study effectively established intraverbal question answering for three young Chinese children with ASD who demonstrated strong echoic behavior in their repertoire. However, using the echoic prompt strategy to teach intraverbal question answering is more efficient than the echoic plus picture prompt strategy for these children. This finding has an important implication in applied settings. For young children with reliable echoic behavior and without systematic instructional experiences, early intervention practitioners can consider using echoic prompts as an efficient instruction to establish and increase intraverbal question answering for them.

References


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Navigation of Social Engagement (NOSE) Project: Using a Self-Directed Problem Solving Model to Enhance Social Problem-Solving and Self-Determination in Youth with Autism Spectrum Disorders

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Chung Yuan Christian University

Abstract: The purpose of the study was to investigate the effectiveness of a three-phased self-directed model in enhancing the social problem-solving skills and the levels of self-determination of students with ASD. A total of 44 junior high school students with ASD were assigned to either an experimental group (n = 24) receiving the three-phased self-directed instruction or a no specific treatment control group (n = 20). Data analysis included bivariate tests and hierarchical linear modeling to analyze teacher- and student-rated scores of social problem-solving (2 domains) and self-determination (4 domains). The findings of this study suggested that after controlling for cognitive functioning and peer/teacher support, (a) students who received the instruction significantly improved their social problem-solving skills when rated by teachers, as compared to those who had not received the intervention; and (b) the participants receiving the self-directed social problem-solving model intervention also made improvements in several domains of self-determination albeit results were not significant. The significant group-by-time effects on social problem-solving implied the effectiveness of the social problem-solving model, meaning that students with ASD became more self-directed problem solvers with the completion of the three phases of intervention.

Current disability-related research and practice emphasizes strengths rather than focusing on deficiency of individuals with disabilities (Palmer, 2015). This emergence of strengths-based conceptualization within intellectual and developmental disabilities (IDD) extends our understanding of disability in general (International Classification of Functioning, Disability, and Health [ICF]; World Health Organization, 2001), supports program development (school-wide positive behavior support [SWPBS]; Horner et al., 2009), and encourages assessments related to identifying and promoting positive and valued character (VIA Inventory of Strengths; Shogren et al., 2015). We also see the need for the educational application of these strengths-based perspectives originating in the field of positive psychology (Niemiec et al., 2017) to embed these principles into instructional designs to promote empowerment and perceived control of people with disabilities. This trend of applying strengths-based approach to people with disabilities includes our focus on individuals with autism spectrum disorders (ASD). This article delineates a self-directed social problem-solving model based on strengths and supports to enhance social problem-solving and self-determination for youth with ASD. The ultimate goal of this Navigation of Social Engagement (NOSE) model is to improve social engagement and social inclusion. Researchers suggest that students with disabilities adjust better to inclusive educational settings if they are equipped with problem-solving skills (Agran et al., 2002; Cote et al., 2014; Palmer, Wehmeyer, & Gipson, 2004; Vlachou & Stavroussi, 2016). Self-directed strategies emphasize supporting students by identifying their strengths and challenges as well as guiding them to be actively involved in a self-regulated problem solving process to

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achieve goals that are relevant to personal values (Lee et al., 2015).

Students with Autism Spectrum Disorders and Their Social Problem-Solving

The two core diagnostic characteristics of ASD are impairments in social communication and social interaction; and secondly, the presence of restricted repetitive behaviors, interests, and activities (Diagnostic and Statistical Manual of Mental Disorders [DSM-V]; American Psychiatric Association [APA], 2013). This most recent DSM-V reflects a single condition with different levels of symptom severity ranging from requiring some support to needing very substantial support, indicating that students with ASD differ in their cognitive functioning and language-related skills. The most salient feature of ASD is the social difficulties, especially in the area of social initiation and social-emotional understanding, which is likely to affect the school adjustment of students now, and affect how people with ASD solve social-related problems in day-to-day adult life (Bonete et al., 2015; Isbell & Jolivette, 2011; Myles et al., 2010). Social problem-solving ability, one of the important components of self-determined behavior, requires a person to understand the concept of having a problem in specific social and cultural contexts, recognize and identify the nature of the problem, generate possible solutions, analyze the best applicable solutions, take actions on planned steps, overcome obstacles and persist, and evaluate the results of problem-solving plans (Cote, 2011; Palmer et al., 2013; Pugliese & White, 2014; White & Roberson-Nay, 2009). In particular, social problem-solving situations typically demand complex social skills such as sophisticated social understanding and spontaneous decision-making and strategic flexibility in social exchanges, with which individuals with ASD often experience difficulties and frustrations if effective problem-solving instructional supports are absent (Cote et al., 2014; Klin et al., 2003; O’Hearn et al., 2008; Ozonoff et al., 2005; White et al., 2010). Several intervention-specific studies have shown that students with intellectual and developmental disabilities, including students with ASD, were able to acquire social problem-solving skills if given appropriate and systematic instruction and support (Bauminger, 2007; Bernard-Opitz et al., 2001; Bonete et al., 2015; Bonete et al., 2016; Cote, 2011; Cote et al., 2014; Pugliese & White, 2014; Vlachou & Stavroussi, 2016).

Challenges in social emotional and cognitive capabilities in autism affect interpersonal and social problem-solving so that (a) individuals with ASD tend to retrieve less contextual features associated with the surrounding environments when generating solutions to hypothetical interpersonal problems; (b) they are likely to focus on the negative and emotional information in social situations impeding the generation of positive assertive strategies; (c) they often produce less socially appropriate solutions and their solutions to social problem-solving are less detailed, less effective and less extended in time (Channon, et al., 2001; Embregts & Nieuwenhuijzen, 2009; Goddard et al., 2007; Isbell & Jolivette, 2011). In addition to lacking necessary social skills related to problem-solving ability, students on the spectrum are inclined to be prompt-dependent if the instructional activities or methods are mainly grounded in adult-prompting or over-protective instruction with operant conditioning and differential reinforcement (Bonete et al., 2016; Brunner & Seung, 2009). The fact that solving social problems is a complex ability and the ultimate goal is to become independent problem-solvers, it is important to promote students’ autonomous problem-solving skills so that they are able to generalize learned information/skills across social settings with adjustment to contextual factors. In this sense, this study embedded self-directed learning strategies, drawing from self-determination theory, into the intervention model to support students with ASD in problem-solving steps.

Self-Determination of Students with Autism

Even though students with ASD display a narrower repertoire of complex emotions and limited social initiations, they and their typically developing peers can benefit from social connections even if students on the spectrum lack the well-developed social capabilities and problem-solving skills to navigate the complex social world (Bauminger, 2002;
Social/interpersonal interactions are often perceived as concerns and navigating through these social situations demands problem-solving skills, which is one of the key elements of self-determination (Cote, 2011; Vlachou & Stavroussi, 2016; Wehmeyer et al., 2003). The literature base promoting self-determination and student involvement has indicated the positive impact of promoting self-determination on valued school-related outcomes, including better social and interpersonal relationships (Shogren et al., 2017). In other words, higher levels of self-determination may support better problem-solving skills, including social and interpersonal problem-solving capabilities. Given the fact that students with ASD experienced less autonomous functioning, problem-solving and other component elements of self-determined behavior compared with other developmental disabilities such as students with intellectual and learning disabilities (Chou, Palmer, et al., 2017; Chou, Wehmeyer, et al., 2017), this study adopted an array of component elements and embedded the strategies for promoting self-determination into the design of the NOSE model in order to increase opportunities to foster self-directed learning and self-regulated problem solving skills for students with ASD. The instructional support included strategies promoting awareness of student social strengths and challenges, setting self-valued social goals, analyzing decision-making and problem-solving methods, and self-monitoring the social situations and action plans. In addition, another essential component utilized in the NOSE model drew from the self-determination literature on the concept of the circle of support affecting one’s quality of life and social adjustment (Eide & Roysamb, 2002; Field et al., 1997; Wineman, 1990). It is evident that students with ASD manifest difficulties in social interactions, and therefore building up strong circles of support would be likely to increase their social capital so that more resources and related personnel could be introduced in the problem-solving contexts providing natural support and reinforcement (Carter et al., 2011; Gotto et al., 2010).
phase to various social problems. The third phase (3 weeks) revolved around real-world problem-solving where students can complete individual social problem-solving workbooks based on scenarios that students were likely to encounter in their own personal lives, followed by role-play practices and group discussion and feedback.

Purposes of the Study

This study examined the effects of using the NOSE instructional model to embed strategies for promoting self-determined social problem solving into typical classroom practice to support students with ASD in middle school. Research questions are:

1. Were there significant differences in students’ social problem-solving (teacher-rated scores) between the experimental and control groups, controlling for their cognitive functioning?
2. Were there significant differences in students’ social problem-solving (student-rated scores) between the experimental and control groups, controlling for their cognitive functioning?
3. Were there significant differences in students’ self-determination between the experimental and control groups, controlling for their cognitive functioning?

Method

Participants

Participants were 44 youth with autism spectrum disorders (ASD) recruited from junior high schools in the northern part of Taiwan. All participants were (a) between 12 and 16 years of age in the 2016–2017 school year; (b) receiving special education and related services designated for the disability category of ASD under The Special Education Act of Taiwan (SEA, 2014); (c) were able to communicate their needs, preferences, and interests verbally or using alternative methods such as augmentative communication or other com-
municative devices; and (d) were able to participate in group discussions or activities such as a team mission of solving a problem or playing a role in a social scenario.

Table 2 shows participants’ demographic characteristics including age, gender, educational placement, cognitive functioning, interaction with peers, support from family and peers/teachers, etc. On average, the youth participants were 13.42 years old ($SD = 0.70$). The majority of the students were male (84.1%); and placed in a resource room in the school (81.8%). Most students interacted with their peers actively (9.1%), somewhat (54.5%), or at least little in a reciprocal way (31.8%). All students had social and/or behavioral problems; and the majority of them received strong support from their family (63.6%) and moderate support from their peers and teachers (52.3%).

### Procedure

A purposive sampling method was used to identify potential participating junior high schools in north region of Taiwan. School personnel and teachers were then contacted after obtaining permission to conduct the study from the university’s Institutional Review Board. Youth participants were recruited through special education teachers who consented to participate in this study. After recruiting a total of 44 students with ASD who met the selection criteria and consented to participate, the research investigator then clustered the participating students by teachers and matched equivalent numbers of students when assigning to the experimental group ($n = 24$) of receiving the three-phased self-directed social problem-solving instruction and to the control group ($n = 20$) of not

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Outline</th>
<th>Instructional Activity</th>
<th>Instructional Support</th>
</tr>
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<tbody>
<tr>
<td>Week 1</td>
<td>Pre-assessments</td>
<td>Collecting baseline data on 1. Overall self-determination 2. Social problem-solving assessments</td>
<td>N/A</td>
</tr>
<tr>
<td>Week 2~7</td>
<td>Phase-1</td>
<td>Teaching social problem solving steps and strategies</td>
<td>● Open-ended design of problem-solving sequences and guidelines ● Establishing circles of support ● Behavioral skills training procedures (instruction-modeling-rehearsal-feedback) ● Brainstorming ● Visual supports</td>
</tr>
<tr>
<td>Week 8~10</td>
<td>Phase-2 (symbolic modeling)</td>
<td>Utilizing materials from books/articles or scripts of daily social situations to analyze problems and solutions</td>
<td>● Scaffolding problem solving process ● Facilitated discussion using the problem-solving steps taught in first phase ● Supporting self-directed learning ● Facilitating circles of support ● Role-play or reader theater</td>
</tr>
<tr>
<td>Week 11~14</td>
<td>Phase-3 (real-world functioning)</td>
<td>Completing individual social problem-solving workbook based on daily social scenarios</td>
<td>● Promoting meaningful student involvement/discussion ● Facilitating self-directed problem solving during completion of individual workbooks ● Facilitating circles of support ● Guided practice ● Role-play and review</td>
</tr>
<tr>
<td>Week 15</td>
<td>Post-assessments</td>
<td>Collecting post-test data on 1. Overall self-determination 2. Social problem-solving assessments</td>
<td>N/A</td>
</tr>
</tbody>
</table>
receiving this instruction. An informed consent was provided from all participating students and their parents or guardians. The researchers and special education teachers who completed a training administered social problem-solving and self-determination measures to the students in small groups or one-on-one sessions. During the measurement, supports and accommodations were provided if necessary.

**Implementing the Model of Self-Directed Social Problem-Solving**

After consenting to participate in the study, teachers received intervention packages containing materials, both electronic and hardcopy, of the self-directed social problem-solving model manual, class activities along with instructional strategies to use for each phases, PowerPoint slides for each lessons, worksheets for students to complete during class activities, measures of social problem-solving and self-determination and administration protocol/guidelines. In addition, three consecutive training workshops (total of 10 hours) plus an additional rehearsal try out session (3 hours) were provided to teachers and research assistants to support the model implementation in order to promote self-direct learning as students conduct problem-solving tasks. During the three intervention phases, the research investigator assembled weekly meetings with teachers and research assistants to assess the progress, review teaching materials, discuss any procedures concerns in that all intervention components were implemented reliably as planned. Each phase of the intervention lasted 5 weeks, for a total of 15 weeks of instruction.

<table>
<thead>
<tr>
<th>Variable</th>
<th>All (N = 44)</th>
<th>Experimental (n = 24)</th>
<th>Control (n = 20)</th>
<th>p</th>
<th>d/V</th>
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<tbody>
<tr>
<td><strong>Age (M ± SD)</strong></td>
<td>43 13.42 ± 0.70</td>
<td>23 13.30 ± 0.70</td>
<td>20 13.55 ± 0.69</td>
<td>2545</td>
<td>-0.35</td>
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<td><strong>Gender</strong></td>
<td></td>
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<td>Male</td>
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<td>22 91.7%</td>
<td>15 75.0%</td>
<td>.2172</td>
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<tr>
<td>Female</td>
<td>7 15.9%</td>
<td>2 8.3%</td>
<td>5 25.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Educational placement</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Regular classroom</td>
<td>5 11.4%</td>
<td>2 8.3%</td>
<td>3 15.0%</td>
<td>.3076</td>
<td>0.26</td>
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<tr>
<td>Resource room</td>
<td>36 81.8%</td>
<td>19 79.2%</td>
<td>17 85.0%</td>
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<tr>
<td>Self-contained classroom</td>
<td>3 6.8%</td>
<td>3 12.5%</td>
<td>0 0.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Itinerant services</td>
<td>0 0.0%</td>
<td>0 0.0%</td>
<td>0 0.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special school</td>
<td>0 0.0%</td>
<td>0 0.0%</td>
<td>0 0.0%</td>
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<td></td>
</tr>
<tr>
<td><strong>Cognitive functioning</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severely impaired</td>
<td>3 6.8%</td>
<td>2 8.3%</td>
<td>1 5.0%</td>
<td>.0207</td>
<td>0.45</td>
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<tr>
<td>Mildly impaired</td>
<td>13 29.5%</td>
<td>3 12.5%</td>
<td>10 50.0%</td>
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<td></td>
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<tr>
<td>Not impaired</td>
<td>25 56.8%</td>
<td>16 66.7%</td>
<td>9 45.0%</td>
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<td></td>
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<tr>
<td>Talented</td>
<td>3 6.8%</td>
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<td></td>
</tr>
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<td>1 4.2%</td>
<td>1 5.0%</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>5 20.8%</td>
<td>9 45.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some</td>
<td>24 54.5%</td>
<td>15 62.5%</td>
<td>9 45.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td>4 9.1%</td>
<td>3 12.5%</td>
<td>1 5.0%</td>
<td>.6690</td>
<td>0.14</td>
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<td></td>
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<tr>
<td>Low</td>
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<td>2 8.3%</td>
<td>3 15.0%</td>
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<td>0.50</td>
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<td>Moderate</td>
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<td>7 29.2%</td>
<td>4 20.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>28 63.6%</td>
<td>15 62.5%</td>
<td>13 65.0%</td>
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<td></td>
</tr>
<tr>
<td><strong>Peer/teacher support</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>5 11.4%</td>
<td>5 20.8%</td>
<td>0 0.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>23 52.3%</td>
<td>15 62.5%</td>
<td>8 40.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>16 36.4%</td>
<td>4 16.7%</td>
<td>12 60.0%</td>
<td></td>
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</tr>
</tbody>
</table>

**TABLE 2**

Demographic Characteristics of Student Participants
Measuring Social Problem-Solving

The researcher developed study-specific teacher- and student-rated social problem-solving questionnaires to measure students’ problem-solving abilities in social contexts. Two sub-domains of the social problem-solving construct measured social problem awareness and self-directed problem-solving. The social problem awareness domain encompasses eight items, measuring students’ perception of their ability to identify the characters of a social problem and understand the important social cues related to the specific problem, e.g., “Does the student notice the change of emotions and feelings of other people in social situations?” The self-directed problem-solving domain consists of 12 items, again measuring students’ perceptions of ability to generate potential solutions to a social problem, develop problem-solving steps, and search for possible resources/personnel in the process of social problem-solving, e.g., “Does the student know with whom he/she can discuss when solving a social problem?” Teachers and students use a 5-point Likert scale (1 = extremely well to 5 = extremely difficult) to rate each item, with possible maximum domain scores of 40 and 60, respectively. Cronbach alpha values were greater than .80 in this study (.85–.96 for social problem awareness; .84–.94 for self-directed problem solving), suggesting adequate reliability for each domain. Both the teacher and student versions of the questionnaire were completed before and after the three-phased self-directed social problem-solving instruction. For the teacher-rated social problem-solving questionnaires, teachers answered the items directly on paper. For the student-rated social problem-solving questionnaires, after being trained in the appropriate administration protocol, teachers and research investigators administered the questionnaires to participating students in small groups or in one-on-one sessions, assisting the students answering the items on paper with accommodations and modifications.

Measuring Self-Determination

This study employed the School-Age Students Self-Determination Scale (SAS-SDS; Chao, 2011), a validated measure of students’ overall level of self-determination. SAS-SDS consists of 37 items categorized into four sub-domains: Self-Awareness contains 11 items measuring student’s knowledge of his/herself; Self-Efficacy contains 10 items measuring student’s perceptions of control; Self-Regulation contains 7 items measuring student’s ability to set personal goals and find means to achieve goals and problem solve; and Autonomous Functioning contains 9 items measuring student’s levels of independence. Students’ ratings on each item are scored using a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). A total self-determination score can range from 37 to 148, where a higher score represents a higher level of self-determination. Besides total score, four domain scores can also be calculated to provide a more detailed profile of students’ self-determination. The SAS-SDS was normed with 2,618 school-age (14-22 years old) students with disabilities in Taiwan (Chao, 2011). It has been proved to have adequate reliability and validity in assessing overall self-determination of students with disabilities (Cronbach’s α = .91). Participating students completed SAS-SDS in groups or individually before and after the three-phased self-directed social problem-solving intervention. Teachers and research investigators were responsible for administering the questionnaires to participating students following the administration protocol, supporting the students to answer each item in reflection of students’ own responses with needed accommodations and modifications.

Analysis

Sample demographics were compared between the students with ASD who received the social problem-solving instruction (experimental group) and those who did not (control group) to determine success/failure of the group assignment, using independent-sample t-test (with Satterthwaite approximation if necessary) for continuous variables and chi-square or Fisher’s exact test (as appropriate) for categorical variables. An effect size, Cohen’s d or Cramér’s V, was calculated for each comparison.

The analysis for hypothesis testing proceeded in two stages. First, independent-samples t-test was performed (with or without the
Satterthwaite approximation as appropriate) to compare teacher- and student-rated scores of social problem-solving and self-determination between the experimental and control groups. Second, hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002; Singer & Willett, 2003) was conducted separately for the social problem-solving scores and self-determination scores. More specifically, models estimated overall group difference across time (i.e., group effect), change over time (i.e., time effect), and group difference in this change (group-by-time interaction), while accounting for the clustering of repeated measurements (level-1) within students (level-2). Models also accounted for the demographic variables that were imbalanced between the groups, thereby providing unbiased effect estimates of the self-directed problem-solving model. A proper structure for error covariances was determined by evaluating relative model fit (e.g., Akaike information criterion, adjusted Bayesian information criterion). Full information maximum likelihood (FIML) was employed for estimation of the model parameters. All analyses were conducted using SAS 9.4 (SAS Institute, 2002–2012).

Results

As shown in Table 2, there were no demographic differences between the students with ASD in the experimental group (n = 24) and participants in the control group (n = 20) in terms of age (p = .25, Cohen’s d = −0.35), gender (p = .22, Cramer’s V = 0.23), educational placement (p = .31, V = 0.26), interaction with peers (p = .32, V = 0.27), and family support (p = .67, V = 0.14). These results indicated that the experimental-control group assignment yielded comparable groups of students, except for their cognitive functioning and peer/teacher support. Thus, support from peers and teachers, irrespective of cognitive function, was controlled for in the HLM analysis when assessing the effects of the social problem-solving instruction.

Social Problem-Solving

Table 3 presents teacher- and student-rated scores of social problem-solving at pretest and posttest, as well as score at two times of measurement. When rated by special education teachers, the students in the control group had significantly higher pretest scores of social problem awareness (p < .01, d = −0.90) and self-directed problem-solving (p < .05, d = −0.78) than those in the experimental group. While the scores for the control group maintained during the study period, the experiment group made considerable gains on the scores through the social problem-solving instruction (p < .001, d = 1.46 for awareness; p < .001, d = 1.75 for problem-solving). Consequently, the experimental group showed significantly higher posttest scores of awareness (p < .05, d = 0.78) and problem-solving (p < .01, d = 1.06) than the control group. When the total scale score was analyzed, similar results were found—i.e., as compared to the control group, the total score for the experimental group was significantly lower before the instruction (p < .01, d = −0.88) but significantly higher after the instruction (p < .001, d = 1.73). These results suggested that the three-phased self-directed social problem-solving instruction has positive effects on social problem-solving among students with ASD. The efficacy of the instruction was further confirmed by the HLM results. The group-by-time interactions were significant (all p < .001; see Table 3), indicating that after controlling for cognitive functioning and peer/teacher support, the pattern of score change was different for each of awareness and problem-solving between the experimental and control groups (see Figure 2).

When students’ self-rated scores were analyzed, the efficacy of the instruction was not far clearly supported. That is, although the experimental group made greater gains on the scores during the study period than did the control group, the group differences in change were not statistically significant (p = .21, d = 0.40 for awareness; p = .86, d = 0.05 for problem-solving; p = .48, d = 0.22 for total score). Correspondingly, the group-by-time interactions were not significant in the HLM analysis (p = .18 for awareness; p = .80 for problem-solving; p = .43 for total score).

Self-Determination

Table 3 shows pretest and posttest scores of self-awareness, self-efficacy, self-regulation, and
autonomous functioning, as well as score changes during the study period. At pretest, the experimental and control groups had comparable scores of self-awareness \((p = .30, d = -0.32)\), self-efficacy \((p = .97, d = 0.01)\), self-regulation \((p = .95, d = 0.02)\), and autonomous functioning \((p = .127, d = 0.48)\). While the scores for the control group maintained or decreased over time, the experiment group made gains, which led to higher post-test scores in the experimental group \((p = .85, d = 0.05\) for self-awareness; \(p = .20, d = 0.39\) for self-efficacy; \(p = .06, d = 1.37\) for self-regulation; \(p = .07, d = 0.79\) for autonomous functioning).
for self-efficacy; \( p = .11, d = 0.48 \) for self-regulation; \( p = .42, d = 0.24 \) for autonomous functioning). However, any of group differences at pretest, posttest, and in change was not statistically significant, providing only partial support for the self-directed instruction. In addition, the group-by-time interactions were not significant in the HLM analysis (all \( p > .05 \)).

Discussion

The present study examined the effectiveness of a three-phased self-directed model designed to increase social problem-solving and self-determination of junior high school students with ASD, resulting in significant increases of posttest scores of teacher-rated social problem awareness \( (p < .05, d = 0.78) \) and self-directed problem-solving skills \( (p < .01, d = 1.06) \) in the experimental group after controlling for cognitive functioning and peer/teacher support.

Implications for Research

The NOSE model utilized self-directed strategies associated with promoting self-determination, to improve the social problem-solving ability of students with ASD. Social problem-solving requires application of social cognitive capabilities, in which students with ASD experience difficulties. The significant group-by-time effects on social problem-solving (both in problem awareness and problem-solving skills) implied the effectiveness of the NOSE model, confirming the success of the essential elements of the intervention design. The model entails a three-tiered intervention plans—Phase one, emphasizing on sequential problem-solving steps; Phase two, utilizing symbolic modeling of social problem-solving behaviors via social scenarios/scripts; and Phase three, focusing on real-world functioning through student-specific social experiences. The design of the tiered-intervention could be used to scaffold and facilitate students with ASD to construct the logical steps of solving social problems, and as a result, students can become self-directed problem solvers. In so doing, particular consideration to the unique social behaviors of autism should also be given in social cognitive areas of (a) recognizing and interpreting social-emotional cues, (b) differentiating central social-emotional information from the peripheral stimuli in social exchanges, and (c) theory of mind-related skills consisting inference of mental and emotional states of others (Aspy & Grossman, 2011; Baron-Cohen & Swettenham, 1997; Bauminger, 2002; Myles et al., 2014). The significant results of group comparison supported the inclusion of these diagnostic characteristics into the design of the scaffolding intervention. Such findings also echo the positive results from previous evidence-based intervention studies applying
sequential method of explicitly teaching problem-solving steps, in the meantime, several pivotal ASD-related elements were embedded within the problem-solving interventions, such as utilization of visual prompts, guiding questions, strategies supporting theory of mind and executive functioning skills, multiple teaching modalities or computer-assisted instruction, immediate and specific constructive feedback, structured delivery of treatment, integrating verbal instruction with visual support systems, and other social cognitive-behavioral strategies (Bauminger, 2002, 2007; Bernard-Opitz et al., 2001; Bonete et al., 2013; Bonete et al., 2016; Cote, 2011; Cote et al., 2014; Pugliese & White, 2014). In addition, the present study’s emphasis on self-directed problem-solving and self-determination was consistent with the investigation of Cote and colleagues (2014) where a three-steps problem-solving instruction was accompanied by the implementation of the Self-Determined Learning Model of Instruction (Mithaug et al., 1998; Wehmeyer et al., 2000) to improve achievement and maintenance of self-selected goals of students with ASD. Similarly, Agran and colleagues (2002) researched a self-regulated problem-solving intervention for student-set target behaviors, providing another source of data-based evidence supporting the successful problem-solving skills acquired through a self-directed learning process.

As far as the impact on the levels of self-determination, despite the improvements in self-awareness and self-efficacy found in the experiment group following the NOSE model intervention, group differences for students were not statistically significant. Responding to the results of non-significant overall improvement in overall self-determination providing only partial support for the self-directed instruction, future research is suggested to embed the component elements of self-determined behavior (e.g., decision and choice-making, goal setting, self-evaluation, perceptions of efficacy and control) into the design of a social problem-solving intervention. In the series design of consecutive problem-solving steps; for instance, future research could (a) use student-initiated social events when formulating social problems to promote self-awareness of social problems, (b) instruct students to specify objectives prior to generating solutions and compare the expected objectives to the results afterwards in hoping to promote goal-setting and attainment, and (c) incorporate other variables promoting self-regulated problem solvers such as self-instructed steps of solving problems, self-evaluated criteria of resolution outcomes, self-generated means to overcome obstacles, to further improve the overall self-determination. This research direction of promoting self-determination of students with ASD aligns with the empirical efforts of linking increased self-determination with better social effectiveness and social inclusion (Algozzine et al., 2001; Koegel et al., 1995; Wehmeyer et al., 2010).

Implications for Educators

The experimental results yield significant advancement in social problem-solving ability in students with ASD, suggesting the usefulness of the NOSE model for educators and practitioners to use to improve interpersonal relationships and social engagements of students with ASD. To be specific, the NOSE model adopted the mental steps of problem-solving process supported by empirical evidence, including encoding and interpreting contextual/social information, clarifying goals for solving problem situations, generating practical solutions, evaluating decisions and self-efficacy (Agran et al., 2002; Embregts & Nieuwenhuijzen, 2009). Educators are encouraged to apply instructional strategies to support these cognitive steps of problem-solving sequences. For instance, educators could break these cognitive steps into different small units, focusing on one mental step at a time with explicit examples or visual cues, which might ultimately and collectively contribute to overall social problem-solving capabilities. Several strategies for teaching effective problem-solving skills have been suggested and can be tailored to meet individual needs of students with ASD, such as brainstorming with sufficient guided practice, practicing problem-solving skill using sample problems that are naturally occurring and student-specific to promote motivation and generalization, assisting students to articulate the thinking process.
of generating solutions and to analyze the reasons of inclusion or exclusion of ideas, applying incidental teaching methods to foster functional communication and social interaction, encouraging students to problem-solve in collaborative groups allowing more diverse point of views and feedbacks (Bauminger, 2007; Bonete et al., 2015; Cote, 2011; Kimhi & Bauminger-Zviely, 2012; Magyar & Pandolfi, 2012; Pugliese & White, 2014). The instructional method of group problem-solving closely parallels with the unique design of the NOSE model—the application of the circle of support in the problem-solving process which encompasses systematic instruction on recognizing and utilizing persons from the student’s circle of support to assist decision-making and solution-generating tasks. From the social validity point of view, it reflects the common practice that a thoughtful solution is typically not deliberated individually but rather with consultation with several trusted and relevant friends or family members. In addition, if educators apply the instruction on circles of support, it gives students with ASD an ongoing means of support to use in future problem solving. Structured teaching of the circle of support includes categorizing different contexts of social problems (e.g., conflicts at school, home, or community), followed by recognizing different groups of people most relevant in each context, developing strategies of requesting assistance and advice on problem-solving tasks, practicing or role-playing skills of working with people from the circle of support.

**Limitations**

Several limitations in the study are listed here. Considering the small sample size of 44 in the current study, the intervention effects should be interpreted cautiously with reference to the population of students with ASD representing a wide continuum of cognitive and communicative functioning, and therefore, a replication with a larger sample is recommended for future research. Another concern relates to the mixed results between teacher-rated and student-rated performance on social problem-solving. Therefore, future research is suggested to investigate the possible reasons and consequences of different perceptions between teachers and students on students’ problem-solving behaviors and skills using norm-referenced measures.

**Conclusions**

One of the positive avenues for improving social engagement is to resolve problems related to interpersonal and social relationships. The tiered NOSE model provides empirically derived evidence supporting students with ASD build up social problem-solving skills and increase self-determination related skills through systematic instructional activities and strategies. By progressing through the three phases of intervention, youth with ASD gradually master the skills of resolving social-related situations as well as to become more self-reliant problem-solver.

**References**


Student involvement in education planning, decision-making, and instruction (pp. 299–328). Brookes.


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The eighth volume of the CEC Division on Autism and Developmental Disabilities’ Prism series, *Friendship 101* focuses on building social competence, friendship making, and recreation and leisure skills among students with autism spectrum disorder and other developmental disabilities. Chapters in this evidence-based, user-friendly guide address the needs of students in different developmental periods (from pre-K through young adulthood), providing teachers, parents, faculty and teacher educators with tools and strategies for enhancing the social skill development of these children and youth. Presented through an ecological perspective, together these chapters emphasize building social competence within and across school, home, and community contexts.

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Education and Training in Autism and Developmental Disabilities

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