Effects of Computer and Classroom Simulations to Teach Students with Various Exceptionalities to Locate Apparel Sizes

Virginia Bramlett, Kevin M. Ayres, and Karen H. Douglas
University of Georgia

Abstract: This study evaluated the effects of simulation training to teach functional community skills to four students with developmental disabilities in middle school. A multiple probe across participants and multiple probe across behaviors allowed for an evaluation of a functional relation between simulation and skill acquisition. Students learned how to match numbers from a shopping list to clothing sizes in a classroom simulation and then generalized this skill to community-based settings. Results are discussed in terms of a rationale for using computer based instruction and classroom simulation for teaching community skills and the potential for video and technology based solutions to augment traditional instruction.

The instruction of functional skills is frequently the focus of education for many individuals with intellectual disabilities (Nietupski, Hamre-Nietupski, Clancy, & Veerhusen, 1986). In order for children with disabilities to become independent and function in a community, instruction includes purchasing and shopping skills. Linking skills and concepts to natural, functional outcomes helps to reduce the likelihood that what is learned becomes “inert knowledge” and that the learner can make use of their newly acquired skills (Whitehead, 1929). Research affirms that teaching skills in the natural environment is most effective for generalization (Cihak, Alberto, Kessler, & Taber, 2004), but for many teachers, teaching solely in the natural environment is difficult due to time, logistics, and money. For that reason, it is essential for special educators to create other opportunities for students to learn and practice skills. Teachers and researchers have used a variety of methods to teach functional skills, as technology becomes less expensive and easier for non-computer programmers to create materials, teachers are able to generate simulations or supplemental materials that share a great deal in common with the stimuli found in the natural environment.

One skill special educators frequently teach to students in the natural environment is shopping. The literature on teaching the complex range of discrimination, academic, and social skills has been done with a mixture of high and low technology instructional strategies. For example, Colyer and Collins (1996) used a system of least prompts to teach the next dollar strategy to students in a classroom simulation. They then conducted generalization probes in the community environments. Three of the four participants learned and generalized the skill but they required over 20 instructional sessions. This raises some questions in terms of whether community based instruction would have led to acquisition in fewer sessions (but perhaps spread across more days) or if community based instruction led to faster acquisition, would it have been less expensive.

In another study, with a slightly different focus, Gumpie and Nativ-Ari-Am (2001) used two different methods to teach students to purchase items. One dyad received intervention using a task analysis and the other dyad used self-monitoring. Training sessions for the first dyad, who were taught using a task anal-
ysis, were done in the classroom and natural environment. Training sessions for the second dyad, who were taught with self-monitoring prompt cards, were taught in the classroom until they achieved a level of 90% criterion, then training in the community began. The interventions were not compared, but both interventions were found somewhat effective and efficient. This begs the question of which is the most efficient method or combination to deliver instruction for these sorts of skills.

While many researchers have documented effective ways to teach shopping related skills in vivo and in simulation, a greater emphasis is currently being placed on technology based solutions. Though there are not a great number of software titles available for teachers to use to teach community skills, some researchers have evaluated proprietary software (Project SHOP) that has begun to influence the software market. Hutcherson, Langone, Ayres, and Clees (2004) investigated the use of software to teach identity match to sample and non-identity match to sample tasks in a computer simulated environment. Students learned to find items from a grocery list on store shelves in simulation and then generalized this to the community setting. In other efforts, Ayres, Langone, Boon, and Norman (2006), replicating Ayres and Langone (2002) used computer based simulations from the Project SHOP software to teach the next dollar strategy. In the replication, the researchers combined computer simulation with classroom practice and students achieved generalized outcomes. This contrasts with the earlier study where students only partially mastered the skill on the computer and never generalized to the community commensurate with their acquisition. In 2008, Hansen and Morgan used aspects of the Project SHOP software that had not been previously researched along with those used by Ayres, Langone, et al. and Ayres and Langone, to teach a shopping sequence that began with locating the shortest shopping line, placing a divider between customer orders on the grocery conveyor, selecting paper or plastic bags, paying for grocery items, and leaving the store. All of their participants acquired the skills, generalized them, and maintained the skills at a 30 day follow up. These studies demonstrated that professionally produced software simulations can lead to generalized outcomes.

Though many students may acquire community related skills via professional produced simulation software, one should assume that anything produced nationally or internationally is unlikely to be able to account for all of the regional and local variation in natural environments. For some students, simulations that do not closely match the natural environment may not promote generalization. To this extent, computer simulations that are teacher generated, relying on stimuli (photos and video) gathered from the local setting hold promise.

The literature is filled with simulation solutions which teachers can create to accurately represent the training and generalization environments where their students live. For instance, several published studies have used Hyperstudio® which predates PowerPoint but has many similar features to create simulations (Langone, Shade, Clees, & Day, 1999; Mechling, 2004; Mechling & Gast, 2003; Mechling, Gast, & Barthold, 2003; Mechling, Gast, & Langone, 2002). To create simulations of community related shopping experiences, all of these examples used video and photographs embedded in the Hyperstudio program with the exception of Langone et al. (1999) which only used photos. All of these researchers effectively designed simulations built around images taken from the natural environment to create instructional programs that led to skill acquisition and generalization.

The purpose of the present study was to examine the combination of computer-based video instruction (CBVI) and classroom simulation as an addition to on-going community based instruction to teach apparel size identification that the students had not yet generalized in the community. Because classroom simulation alone may not be sufficient for generalization to the natural environment (Ayres & Langone, 2002) and CBVI may not provide enough practice of the topography of the behavior, the combination of the two may be beneficial (Ayres & Langone). Unlike Ayres, Langone, Boon, and Norman (2006), this study probed the student in the classroom simulation prior to CBVI during each session. The classroom and computer simulations for this study incorporated a variety of sizes, allowed for practice with the topography of the behavior, and provided multiple exemplars of the tags and labels. Generalization measures
were collected in the natural setting during a pre and posttest.

The study’s primary research question was: What effect would CBVI combined with live classroom simulation have on student’s ability to locate a specific size? Secondly, the study examined whether the students were able to generalize the skills learned through CBVI and classroom simulation to a community store. The dependent measures for the probes, intervention (classroom simulation), and generalization were the percent of items found correctly.

Method

Participants

Four students (2 male and 2 female), aged 12–15 years old, participated in the study (see Table 1). Todd, Oliver, Annie, and Katy attended school at a rural middle school and received special education services focused on functional skill instruction and functional academics. They spent a half-day per week in community based instruction. Each student’s level of computer experience varied. Kay regularly used a computer at home. While Annie had a computer at home, she was reported to rarely use it. Neither of the young men had computers at home. All students had experience using a mouse and keyboard on the classroom computer where they engaged in regular learning activities.

Participants were selected based on the following criteria. First, they had IEP goals related to independently locating items in a store from a list. Second, they demonstrated the following pre-requisite skills: (a) identification of numbers (1–15, including ½ and .5),

Table 1. * Kaufman Test of Educational Achievement (Kaufman, 1985)*

<table>
<thead>
<tr>
<th>Student</th>
<th>Age</th>
<th>Diagnoses</th>
<th>Standard Scores/IQ</th>
<th>Strengths</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annie</td>
<td>15yrs 4m</td>
<td>Moderate Intellectual Disability, Speech and Language Impairment</td>
<td>40***</td>
<td>Self-help skills, independently navigates school building, reading functional sight words, using a calculator to total prices of items purchased, and writing her personal information that includes address</td>
<td>Counting mixed groupings of bills and coins, spelling, writing complete sentences, and multi-step math tasks</td>
</tr>
<tr>
<td>Katy</td>
<td>12yrs 3m</td>
<td>Other Health Impairment, Speech and Language Impairment</td>
<td>60*</td>
<td>Computer savvy, easily uses word processor and Microsoft PowerPoint™</td>
<td>Academic areas, difficulty focusing, extremely compulsive, frustrates easily</td>
</tr>
<tr>
<td>Oliver</td>
<td>12yrs 0m</td>
<td>Moderate Intellectual Disability, Speech and Language Impairment</td>
<td>30**</td>
<td>Hard worker, friendly, ability to complete routine tasks once mastered</td>
<td>Functional academics, communication skills, self-help skills, pre-vocational skills</td>
</tr>
<tr>
<td>Todd</td>
<td>12yrs 1m</td>
<td>Mild Intellectual Disability, Orthopedic Impairment</td>
<td>57***</td>
<td>Knows multiplication facts for 3, 5, &amp; 7, fluent reader, good oral reading skills</td>
<td>Functional academics, adapted curriculum, deficits in academic areas, communication skills, &amp; social skills</td>
</tr>
</tbody>
</table>

* Kaufman Test of Educational Achievement (Kaufman, 1985)

** Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984)

*** Wechsler Intelligence Scale for Children Revised (Wechsler, 1974)
(b) identification of letters, (c) object recognition of shirts, pants, and shoeboxes, (d) visual ability to see the shopping list and read labels, (e) ability to use a computer mouse and click on one of three $2 \times 3$ in. picture choices, (f) ability to attend to task for 10–15 min, (g) ability to match to sample, and (h) motor skills necessary to physically handle objects in the simulation and natural environment. The first author assessed each student for these skills. For each task, the criterion for mastery was 100% accuracy and independence.

Setting and Arrangements

Community setting. Generalization and screening sessions took place at one local store that participants regularly visited with their parents. These sessions were conducted in a one-on-one arrangement. Other students not engaged in testing at the time, worked on unrelated skills in other parts of the store with the teacher and paraprofessionals.

Classroom and computer settings. The students’ classroom was located at the end of a hallway. In this hallway, the teacher created a simulated store environment that included a clothing rack (Mainstays home rolling garment rack) with pants on hangers, a table with stacks of shirts, and shoeboxes stacked on a shelf. While a student participated in the simulation in the hallway, the other students were working in the classroom with the teacher. CBVI took place at a desk adjacent to the simulated store. Students sat in a chair facing a laptop computer with the researcher standing beside or behind them. The simulation and CBVI each lasted approximately 10 min and occurred two to four days per week. A video camera positioned in one corner of the hallway filmed all interactions to allow monitoring of interobserver agreement and procedural fidelity. See Table 2 for setting characteristics.

Materials and Equipment

Target stimuli in simulation and CBVI. Because the sizes for men and women’s shoes vary from size 5 to size 13 and include every half size in between and men’s pants sizes include two numbers in various combinations, the researcher selected a sample of four to eight sizes from each set to include in the CBVI. For example, only the sizes XS, S, M, and L were included in the pictures for computer simulation for shirt sizes, and the shoe size sets were composed of only the sizes $4 \frac{1}{2}$, 6, 8, $9 \frac{1}{2}$, and $10 \frac{1}{2}$. Sizes that sampled the range

| TABLE 2  |
|---|---|---|
| Characteristics of Settings |
| **Computer Simulation** | **Classroom Simulation** | **Natural Environment** |
| - Intro video of locating items in natural environments | - Rack of pants on hangers | - Racks of shirts and shorts/pants |
| - 3rd person point of view video | - Pants that sample the range of exemplars | - Tables of shirts and pants |
| - Discrete trials- S D “Find (item highlighted on the shopping list)” then three pictures of tags to choose from | - Table of stacked shirts | - Shelves (slanted) with shoe boxes |
| | - Shirts that sample the range of exemplars | - Possibly noisy |
| | - Shelves (flat) of shoe boxes | - Variety of environmental print (signs, etc.) |
| | - Shoe boxes that sample the range of exemplars | - People (others may be looking at the same item) |
| | - Fairly quiet | |
from both women’s pants (i.e., 2, 8, 10, and 14) and men’s pants (i.e., 30x28, 33x30, 40x29, and 36x34) also made up each set. Since it is logistically difficult and time consuming to teach every combination of numbers and the typical person is not taught every combination of sizes, the researchers wanted to see if student responses would generalize from the computer simulation to the classroom simulation or natural environment. If during intervention a student was taught to find an “XS” when an “XS” is on the shopping list, can he or she find an “S” in the community when he or she did not see the size in the CBVI? The researcher included each student’s size in the exemplars to ensure the student learned his or her size directly.

CBVI. The researcher created video vignettes of a person searching to locate apparel in a store. The vignettes began each CBVI session. These were from the third person point of view, as if the student was watching another person locate the item. The researcher used a small handheld camcorder (Pure Digital Technologies Flip Video Ultra Series) to record the vignettes. The vignettes were displayed on the screen in a 7 in. × 10 in. window and played at the beginning of the computer simulation in PowerPoint™.

The researcher used a Canon PowerShot SD 1000 Digital Elph to take pictures of clothing labels and shoeboxes for the CBVI. The clothing labels and shoeboxes sampled the range of apparel size presentations. A wide variety of colors, fonts, and layouts naturally make up the tags and boxes, thus, it was important to the researcher to capture as many different types of tags and boxes possible. Photographs of clothing labels and shoeboxes were inserted into PowerPoint™ to create the multimedia instruction. Photographs of the shopping lists (described next) were inserted into the PowerPoint slides (see Figure 1). Once the photographs were inserted into the computer program they were sized to about 2 1/2 in. × 3 1/2 in.

Classroom probes. Pants were hung on a Mainstays home rolling garment rack, shirts were folded and stacked on a classroom table, and shoeboxes were stacked on a shelf. The tags from the pants and shirts were cut out and Velcro™ was placed in the pants and shirts, as well as on the backs of the tags. Also, shoe sizes were printed on paper and Velcro™ was attached to the backs of the papers and on the boxes. This was done to facilitate randomization of sizes so that students did not learn that a certain item was a certain size. For instance, there was one pair of women’s pants with a bright flower pattern. It was important that the student did not over select on the irrelevant stimuli of the patter and instead focused on the size. Tags were randomly changed before each session. Various shopping lists were made in Microsoft Word 2007™ and printed on a Hewlett Packard 5550 printer. Each shopping list measured 1.5 in. × 2.5 in. and included two to five of the same item (depending on the individual student needs). All students except for Oliver used a one page list containing five items. Oliver’s list was two pages and included three items on one, and two items on the other. The researcher laminated the shopping lists and each day drew five random sizes out of a bag and wrote the sizes on the corresponding list with a wipe off marker in order to randomize the sizes.

Community store. The only materials required for the natural environment were the shopping lists described above, data collection sheets, and a stop watch. The format of the shopping list remained the same (with varying items and sizes) for every condition in effort to hold all variables constant.

Response Definitions and Recording Procedures

For classroom simulation and the natural environment (generalization and screening probes), the dependent variable was the percent of items located correctly. Event recording was the chosen recording procedure. A correct response was scored when the student located the target stimuli from the shelf, rack, or table by pointing or handing the correct size item to the researcher within 60s of being given the SD. For CBVI, the dependent variable was also percent correct. A correct response consisted of clicking on the correct tag size on the screen within 15s of reading or being read the $S^D$ (shopping list). The student did not have the ability to self-correct during CBVI. An incorrect response for all three settings (i.e., CBVI, classroom simulation, and natural environment) consisted of the student selecting the incorrect size or exceeding the
Figure 1. Screen shots of slides in PowerPoint
duration. Only correct responses counted towards criterion.

General Procedure

The study consisted of three conditions: pre/post generalization and screening probes, classroom probes, and CBVI. Two to four sessions occurred per week with each student receiving no more than one instructional session per day. During the intervention condition, students began the session with classroom probes and then took part in CBVI; this lasted about 10 min. The study began by screening the four participants on four size related matching skills (men’s pants, women’s pants, shirts, and shoes) in the natural community to identify the skill or skills that the students could perform. Three of the four students could match most of the items on a list to items in the store with the exception of men’s pants (which require matching a waist and inseam number). Annie had difficulty with both men’s and women’s pants and Oliver could not successfully make any of the matches consistently. This screening also functioned as the generalization pre-test.

After this pretest, three additional baseline probes were conducted in the simulated classroom environment. Once students’ probe data stabilized with no upward trend, intervention began. During intervention, sessions began with a probe in the simulation and then CBVI. Once the student reached criterion (100% correct on 3 out of 4 sessions) on classroom simulation, the next student began intervention (if baseline probe data were stable) in the multiple probe across participants, or the student began intervention on the next behavior in the multiple probe across behaviors (Oliver). After a student reached criterion, he or she was probed again for generalization in the natural environment.

Generalization Assessment Procedures

The pre-test screening was essential to the study to evaluate whether students could locate apparel sizes in the natural environment prior to the study. In order to see if stimulus generalization occurred, post-test measures were taken after a student reached criterion in the classroom simulation in the natural environment. These in-vivo generalization trials were presented in the same form as the classroom simulation. Once in the store with the class, the researcher worked with students individually. Sessions began with the researcher directing the student toward the proper area to locate the items (e.g., shoes). Then the researcher handed the student the shopping list with five different sizes on it and said, “Find the items on your list.” After the student picked up their first item (regardless of accuracy), they were directed to continue until they finished their list. For every correct answer, the researcher placed the item in the cart and provided positive praise such as “good job.” If the student answered incorrectly, the researcher simply placed the item in the cart. These sessions lasted approximately 10 min. Using the pre-test generalization probes as a screener allowed us to determine which target behaviors a student could perform and which required instruction. If a student was able to find 4 out of 5 items, this skill was not included in the study for that student. Following the pre-test, the remaining experimental conditions were sequenced so that three students received instruction in the context of a multiple probe across participants (Todd, Katy, and Annie) and one student received instruction in the context of a multiple probe across behaviors (for Oliver). These groupings were based on the pre-test screener that indicated that Oliver struggled with all skills and the other students only had difficulty with a single skill.

Simulation Probe Procedures

At least three consecutive probes in the classroom simulation occurred before introducing intervention. The probe condition served a similar function as the pre-test; it evaluated if the student could do the skill or not in the classroom simulation. The researcher collected probe data intermittently throughout the study to monitor for history and maturation. Each probe session began with the researcher directing the student to the classroom simulation area. The researcher handed the student the shopping list and told the student to find the items on the list. The researcher recorded each size the student found on the data sheet and whether the re-
sponse was correct or incorrect, or if the student gave no response. For every correct answer, the researcher provided positive praise such as “good job.” If the student answered incorrectly, the researcher prompted the student to go to the next step without any other response. After the student located the first item, the student was directed (if needed) to complete the list. Three of the four students found the items on the list out of order and pointed out the corresponding size on the list to confirm he or she found the correct size. For each item, the researcher collected data on the apparel size located. Each probe session consisted of five trials of the same apparel item of differing sizes. Correct responding was reinforced across conditions so as to guard against inhibitive testing effects and so that only one variable was changed from baseline to intervention (rather than only reinforcing correct responses during intervention).

**CBVI and Classroom Simulation**

The independent variable for this study consisted of a combination of CBVI and behavioral rehearsal in the classroom simulation. Following stable probe data for the first behavior or student, intervention began. Each session of intervention consisted of five trials in the classroom simulation followed by a set of 10 trials of CBVI.

Each intervention session began with the researcher directing the student to the classroom simulation. The researcher handed the student a shopping list and told the student to find the items on the list. Once the student found the first size, he or she should proceed to the next item on the list. The only prompt the researcher gave was a prompt to find the next item if needed. If the student found the correct item, the researcher provided a positive praise statement such as, “Good job.” If the student found an incorrect item, the researcher simply took the item without a response and prompted the student to continue. Students did not have to find the items in the order on the list. These simulation trials were recorded daily and used as the primary dependent measure for making research decisions. The student completed five trials and then the researcher directed the student straight to the computer.

After each probe session, CBVI began with a short 15–30 s video of a person locating an item. Following the video introduction, computer based instruction began. The next slide showed a shopping list (the same as the student used in-vivo) with a red box around the item and size to identify. Below the list, there were three picture choices. If the student clicked the correct size, the simulation proceeded to a slide with the text “good job” (for students who could not read, the teacher read the statement). Students then clicked a blue arrow in the bottom right hand corner of the screen to proceed to the next trial. If they did not click the button within 5 s, the computer prompted them to click the arrow. If the student chose an incorrect answer, they were shown a slide with the text “wrong” and a picture of the shopping list and the correct label. Again, the teacher read the slide to the students who were non-readers. A red circle was overlaid on the size on the tag to draw the student’s attention to the correct size. The student did not have the option to self-correct, but would click the blue arrow again to proceed to the next trial. Each trial had the same layout with a different shopping list and size choices. The computer simulation consisted of 10 trials. The researcher sat or stood near the student to help navigate the program and read the correct and incorrect slides if needed.

The researcher provided verbal praise to students on a VR-2 schedule contingent on correct responses to the CBVI. Once students achieved 5/5 correct responses in the simulation in three out of four consecutive sessions, the generalization post-test condition began.

**Experimental Design**

As previously stated, a multiple probe design across three participants was used to evaluate a functional relation between intervention and skill acquisition for Todd, Katy, and Annie. In addition, a multiple probe across behaviors was used to evaluate experimental control for Oliver. The choice to use two experimental designs running independent of one another was made because of the varying ability levels and needs of the students and because this option allowed the best opportunity for inter and intra-subject replication.
This combination also granted the opportunity to evaluate effects of intervention at three or more points in time (Horner et al., 2005) which is an important criterion for judging whether or not a functional relation exists between an intervention and changes in a dependent measure.

The multiple probe across participants and multiple probe across behaviors designs both consisted of a time-lagged introduction of the intervention (CBVI and classroom simulation) which helped control for threats to history and maturation (Gast, 2010). Collecting data across three tiers of students and behaviors controlled for maturation. This design allows for detection of history effects not only because of staggering intervention across tiers, but also because of intersubject replication. Intervention was only introduced after data was stable, and the changes in data only occurred upon intervention. Because students did not know the researcher prior to the study, she spent some time in the class and community prior to the study to control for adaptation threats. Multiple trials on a skill one does not know how to do can be extremely frustrating, and since testing can be a serious threat to this design, the researcher positively praised students on correct responses throughout baseline to control for inhibitive testing effects (facilitative testing effects would be revealed in the data if they occurred). Reliability checks controlled for instrumentation threats. In addition, a pre and posttest evaluated the extent to which generalization from intervention to the natural environment occurred. Therefore the sequence of conditions was, (a) pretest generalization probe (community), (b) baseline: classroom simulation probes, (c) intervention: CBVI plus classroom simulation, and (d) posttest generalization probes (community).

Reliability

The classroom teacher, a paraprofessional, and another graduate student in special education collected interobserver agreement (IOA) and procedural reliability simultaneously. For each student these data were gathered during all pretest and posttest sessions, 25%–50% of all probe conditions, 25%–60% of all classroom simulation sessions, and 25%–50% of all CBVI sessions. The graduate student recorded procedural fidelity of baseline probes and intervention by watching video recordings of sessions. The researcher trained the observers by showing videos of possible responses and modeling correct scoring procedures until 90% agreement occurred. The researcher served as the primary data collector during CBVI and recorded the student’s computer responses. However, all IOA sessions in the classroom were videotaped to allow for later, independent, scoring by the reliability observers. During pre/post-test generalization probes the classroom teacher and paraprofessionals collected IOA and procedural fidelity in the community where videoing was not feasible. The researcher calculated reliability data using the point-by-point method: agreements divided by the agreements plus disagreements, multiplied by 100 (Cooper, Heron, & Heward, 2007).

Reliability observers collected procedural reliability on the researcher’s behaviors for each condition as well. The following researcher behaviors varied slightly between the computer simulation, classroom simulation and community. Behaviors observed for the CBVI were: (a) researcher sits next to the student, (b) researcher has the computer program on and ready, (c) researcher reads the computer screen, (d) researcher scores the task on the data sheet, (e) researcher provides corrective feedback and praise at the correct time, (f) researcher helps the student navigate the computer program if needed, and (g) researcher does not prompt responses. The behaviors observed for the classroom simulation and community were: (a) researcher positions student in front of correct apparel, (b) researcher says the student’s name, (c) researcher hands the student the shopping list and says, “Find the items on your list,” (d) researcher scores the task on the data sheet, (e) researcher provides corrective feedback and praise at the correct time, (f) researcher does not provide prompts, and (g) researcher prompts the student to move to the next trial (or the student may move to the next trial independently). To calculate procedural reliability, the researcher divided the number of correct steps completed by the total number of steps necessary and multiplied by 100 (Billingsly, White, & Munson, 1980).
Social Validity

Social validity data were collected using a survey in the form of a Likert scale. All four students’ parents received the survey, as well as the classroom teacher and paraprofessionals. One student’s parent, one teacher, and two paraprofessionals returned the survey and provided feedback on the usefulness and effectiveness of the multimedia simulation and classroom simulation. The scale ranked from 1 (strongly disagree) to 5 (strongly agree). The parents and teachers received the survey after the final generalization probe and were asked to return it within a week.

Results

Reliability

IOA was 100% for the CBVI (selecting the correct size on the computer), classroom simulation (selecting the correct size apparel), and the natural environment (selecting the correct size apparel) throughout all conditions. Procedural fidelity was calculated in every condition. Procedural fidelity for probe conditions was 100%, classroom simulation was 99.3% (range = 96.67–100%), and CBVI was 98.2% (range = 93–100%). Mean procedural fidelity for the pretest was 100% and 98.6% (range = 96.67–100%) for the posttest. All disagreements were attributed to prompting. For CBVI every error was with Oliver. Todd, Katy and Annie all were able to read the program and went through it quickly and easily. Since Oliver was a non-reader, the researcher read the entire computer simulation to him; this led to errors of prompting.

Effects of Intervention

The study consisted of 23 sessions and lasted about six weeks. Figure 2 depicts the responding of Todd, Katy and Annie and Figure 3 shows Oliver’s performance data. Closed squares represent the percentage of correct responses during classroom and community probes, while the bar graphs represent the percentage of correct responses during CBVI.

Todd. In the pre-test generalization screening, Todd responded at 100% correct for three of the four skills (shoes, shirts, and women’s pants) and 40% correct for men’s pants. Therefore men’s pants sizes were selected as his target skill and subsequently, in the classroom simulation, he responded between 0% and 20% during baseline. Upon introduction of intervention, he answered 100% of the questions correctly on the computer probes. After two sessions of intervention, his data increased from 0% correct to 100% correct on identifying the correct men’s pants size. He continued to respond at 100% correct in classroom simulation maintenance checks and to 100% of the posttest generalization probes two weeks after reaching criterion in intervention.

Annie. When Todd began intervention on men’s pants, Annie began intervention on women’s pants. During screening she responded at 100% correct on shoes and shirts but 40% on women’s pant sizes and 0% on men’s pants. Therefore woman’s pants became the first target skill for Annie and after she mastered this skill (and Katy mastered her target), Annie began intervention on her second skill, men’s pants. Intervention on this second skill was delayed until after Katy mastered her skill to allow for another demonstration of intervention effects at a third point in time. During classroom simulation, she responded between 0% and 20%, remaining stable with no increase in data on women’s pants. Once intervention began, Annie’s data increased from 0% to 40%. On the third day of intervention, her data dropped to 20%, then after three days of computer plus classroom simulation she responded to 100% correct. Four sessions later, after reaching criterion, she was probed in the classroom simulation and responded to 100% correct. When she was probed in the community, she responded at 100% correct. For her second target skill, she completed five baseline probe sessions before she had the opportunity to begin intervention. Four out of five probes remained at 0% correct and one was at 20% correct. Her baseline levels on men’s pants remained low, despite the fact that she was receiving intervention on women’s pants. Once intervention began on this skill Annie scored 100% correct on all computer probes. After one computer probe, Annie’s data jumped from 0% to 80% during classroom simulation. After the second computer probe
Figure 2. Multiple probe across participants with the percent correct represented with open squares in the natural environment, closed squares in classroom simulations, and bars during CBVI.
Figure 3. Multiple probe across behaviors for Oliver with the percent correct represented with open squares in the natural environment, closed squares in classroom simulations, and bars during CBVI.
her percentage correct increased to 100% and remained at 100% the next two probes to reach criterion. She correctly responded to 100% of the posttest generalization probes.

**Katy.** Once Annie met criterion on women’s pants, Katy began intervention. During the pre-test generalization screening, she had responded at 100% correct for all skills except for men’s pant sizes for which she only got 20% correct. In the classroom simulation, she responded 0% correct 5 out of 6 times, the third probe she answered one size correctly. After one session of computer simulation at 100%, her classroom simulation probe increased from 0% to 100%. Out of five classroom simulation probes, Katy scored four 100% correct and one 80% correct (she missed one answer). She scored 100% on all computer probes. She correctly responded to 80% of the posttest generalization probes.

**Oliver.** During pre-test generalization screening, Oliver scored 0% correct across all skills. In the classroom simulation he scored between 0% and 20% (1 or 2 correct out of 5) in the classroom simulation probes. Upon introduction of intervention for his first skill, shoes, his accuracy remained low. He continued to respond accurately between 0% and 20% on identifying the correct size in the classroom simulation. His responses to the CBVI remained variable, between 20% and 60% during the first five sessions of intervention. After the fifth session, the researcher conducted one session of direct instruction. The researcher found the items with the student and pointed out the matching numbers. After this change, the percentage of correct responses increased to 60% for three consecutive sessions, then to 100% and 80% for the next four sessions when the student reached criterion. The CBVI data remained variable. He responded at 80% correct in the posttest generalization probes two weeks after reaching criterion. The second behavior introduced was the identification of shirt sizes. He responded at 20% correct in the pretest in the community and his baseline probes were between 0% and 20%. After introduction of CBVI, his data increased to 80% and after two computer sessions his data increased to 100% and he reached criterion. He responded at 100% correct in the posttest generalization probes a week after reaching criterion. This improvement occurred without direct instruction on this skill.

The final behavior to receive intervention was the identification of women’s pants sizes. He responded at 0% correct during the pre-test probe and at 0% during the classroom simulation probes. Upon introduction of intervention, Oliver’s data increased from 0% to 60%. He remained at 60% for two sessions of CBVI and classroom simulation, then after the third session he responded correctly to 100% of the classroom simulation probes for three consecutive sessions. CBVI data remained variable. The generalization posttest was the following day, and remained at 100% correct. This skill also increased without direct instruction.

**Social Validity**

Social validity data is located in Table 3. Out of the four parents who received the survey, only one parent returned the survey. The teacher and paraprofessionals all returned the survey. All four surveys returned reported favorable opinions related to the importance of the skill and the usefulness of simulation.

**Discussion**

The purpose of this study was to evaluate the effects of a combined CBVI and behavioral rehearsal in classroom simulation to teach individuals with intellectual disabilities to identify clothing sizes. Additionally, pre-/post-test generalization probes were used to evaluate whether or not students transferred the skill to the natural environment. Overall, CBVI combined with classroom simulation was effective to teach these four students to identify the correct apparel sizes. Generalized responding in the natural environment was also evidenced.

In terms of documenting a functional relation between intervention and student responding, the combination of the multiple probe across participants and the multiple probe across behaviors allowed for more than three demonstrations of effect at three points in time (the standard recommended by Horner et al., 2005). In the multiple probe across participants, there were four demon-
strations of effect over three points in time. This included inter and intra subject replication. For the multiple probe across behaviors, (Oliver), there were additional demonstrations of effect over three points in time.

Because it is somewhat unusual to have one student appear twice in a multiple probe across participants, we want to draw the reader’s attention to Annie. She began intervention on women’s pants at the same time as Todd. Then, as the third tier of the multiple probe, she began her second intervention on men’s pants. Visual analysis reveals that intervention was most likely the causal factor in her learning because her baseline levels for men’s pants (her second behavior) did not rise until she received intervention on that skill even though intervention was occurring on her first target skill (women’s pants).

During generalization probes, students were also able to locate untrained sizes. Nietupski et al. (1986) suggested that a range of training exemplars be used in order to promote generalized responding. Overall, generalized responding occurred, but the researcher observed one main area where the exemplars did not vary enough. The fonts used on the computer remained consistent, as well as the researcher’s handwriting on the shopping lists. When Oliver reached the generalization post-test and had the shoe size “9” on his shopping list he could not find it. Though there were multiple size nine shoeboxes on the shelves before him, the numbers all had a “9” with a tail (looks like an upside down 6). The computer font chosen for the CBVI was consistent with the line of the nine straight down, which matched the researchers handwriting. Thus, one limitation of the study is a lack of variation in font exemplars.

It is also notable that Oliver never mastered the computer sessions. The CBVI provided instructive feedback on a slide when the student got the answer wrong. It simply said “wrong” then provided a picture of the shopping list and tag with the size on the tag.

### TABLE 3

Social Validity Survey Results: 1 (strongly disagree) to 5 (strongly agree)

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean Score</th>
<th>Question</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The student became more independent finding different sizes following intervention.</td>
<td>4.5</td>
<td>7. My opinions have changed since the beginning of the study.</td>
<td>1.75</td>
</tr>
<tr>
<td>2. The student will use the skill of identifying clothing sizes often.</td>
<td>4.5</td>
<td>8. I will let my child help shop for his/her own clothing. *for parents only</td>
<td>4</td>
</tr>
<tr>
<td>3. Simulation (training that is similar to the natural environment, but set up in the classroom) is reasonable for student learning.</td>
<td>4.75</td>
<td>9. Clothing location skills are important.</td>
<td>4.75</td>
</tr>
<tr>
<td>4. Simulation is a useful teaching tool.</td>
<td>4.75</td>
<td>10. The simulation (classroom store and computer program that represents the natural environment) is responsible for the child’s ability to locate correct sizes.</td>
<td>4.25</td>
</tr>
<tr>
<td>5. The student really learned how to locate the sizes.</td>
<td>4.67*</td>
<td>Comments:</td>
<td></td>
</tr>
<tr>
<td>6. This skill is feasible to use in a vocational setting.</td>
<td>4.75</td>
<td>-1 Teacher, 1 parent, and 2 paraprofessionals returned the survey</td>
<td></td>
</tr>
</tbody>
</table>
*3/4 surveys answered question
circled. The researcher hypothesizes that since Oliver got so many incorrect, the extra focus on the tag size on the incorrect slide could have helped him focus on what to look for when looking for a size in simulation. Further, it was apparent during the instruction of Oliver’s first skill that history training (learning to use the software and understand what was being taught) might have led to faster acquisition as he did not begin to respond to CBVI until the teacher walked him through the program.

While Ayres and Langone (2002) suggested production and research in the area of commercially produced software is needed, this study provides further evidence for the potency of teacher generated CBVI that Mechling (2005) suggested may be more immediately useful because it is individualized to student needs. The computer simulation used in this study used Microsoft PowerPoint— which did not electronically collect the data, thus the computer program does not allow for students to independently work with the program. Further research on other types of computer programs that are easily accessible to teachers and researchers and are useful in creating simulations are needed. Ideally, students should be able to work on the computer independently and multiple times a day for extra practice as suggested by Hutcherson et al. (2004) and PowerPoint limits this. Though PowerPoint may not allow for electronic data collection, it is readily available to most teachers and researchers, and it can be easily manipulated and altered according to the needs of a student, thus making it a useful tool for educators. Hence, further research on how PowerPoint can be better used independently by students would also be beneficial.

As suggested by Ayres and Langone (2002) and carried out by Ayres, Langone, Boon, and Norman (2006), this study combined CBVI with classroom simulation. Unlike the Ayres, Langone, Boon, and Norman (2006) study, this study presented the classroom simulation before the CBVI. We believe this allowed for a more authentic evaluation of generalization from computer environment to real materials because if the instruction and classroom simulation were sequenced differently, students would move immediately from CBVI to classroom simulation and one would expect inflated performance. Further research is needed on the effectiveness and the order of combining the two however, as well as the sequencing with true in vivo community based instruction (Cihak et al., 2004). Many studies have examined simple identification skills, but supplementary research is needed on teaching complete activities (Morse, Schuster, & Sandknap, 1996). Therefore, it would be beneficial to evaluate whether or not computer and classroom simulation combined would be effective in teaching the entire activity of clothing shopping (locating items, going to an open register, paying for the purchase). Also, Oliver never mastered computer sessions and only attained the skill after the researcher did one session of direct instruction. This begs the question as to whether or not direct instruction during classroom simulation would be more efficient than the computer and classroom simulation combination.

Overall, the results of this study show that computer and classroom simulations combined can be an effective tool to teach functional skills like identifying apparel sizes. The study reveals that computer and classroom simulation is a suitable support, not a substitution for community based instruction. Though more research is needed, computer and classroom simulations provide teachers with additional means for instruction, possibly saving time and money.

References


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