Computer-Based Instruction for Purchasing Skills

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Abstract: The purpose of this study was to investigate use of computers and video technologies to teach students to correctly make purchases in a community grocery store using the dollar plus purchasing strategy. Four middle school students diagnosed with intellectual disabilities participated in this study. A multiple probe across participants research design was used to evaluate the effectiveness of the treatment. Results indicated the program was effective at teaching the dollar plus purchasing strategy to three out of four participants and promoted generalization to the natural environment. Finally, limitations of the study, implications for practice, and future research questions are discussed.

Stokes and Baer (1977) highlighted several features of instructional programs that promote generalization. Two of those features relative to effective instruction of community skills (e.g. shopping, ordering from a menu, navigating public transit) are the programming common stimuli and training of sufficient exemplars. Programming the common stimuli generally requires being in the environment where those stimuli exist and programming sufficient exemplars requires time in that environment. This may become an obstacle to teachers planning community-based instruction [CBI] because of logistics and cost involved in providing instruction in natural environments (Wissick, Gardner, & Langone, 1999). Thus, teachers need to monitor efficiency of CBI to maximize the opportunities for their students and search ways to enhance their instruction. One possibility for this is to supplement CBI with classroom simulation. To expect generalization from classroom simulation to the natural environment, however, will require careful planning on the part of teachers to make sure that the simulations match the natural environment to the fullest extent possible.

To create realistic opportunities for students with disabilities to practice community-related skills in the classroom, teachers have to focus on making the simulation as close to real life as possible. Ideally, no teacher would want to teach a community skill solely in the classroom, but time in the community to practice skills sufficiently may be cost prohibitive and logistically difficult. If teachers are able to supplement their community-based instruction with classroom simulations, they may be able to stretch the utility of their overall instructional program (e.g. Mechling, 2004). To be useful though, the skills practiced or learned in the simulation need to generalize to the community setting.

Morse, Schuster, and Sandknap (1996) recommend focusing instruction on shopping skills in the broadest sense to incorporate the whole experience of going to the store. It may be possible to isolate certain skills that may be more easily simulated in the classroom than others and thus, leaving most of the instructional time available for skills that would be difficult to simulate in the classroom (e.g. asking for help when one cannot locate an item). Branham, Collins, Schuster, and Kleinert (1999) demonstrated that classroom simulation combined with in vivo instruction was more efficient for teaching check cashing, street crossing and letter opening than community-based instruction combined with video taped modeling or video taped modeling and classroom simulation.

There might be instances when teachers might choose to isolate certain skills to be taught primarily in the classroom and depend-

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ing upon the quality of exemplars used in the simulations, the instruction could be effective in teaching certain skills. For example, Mechling and Gast (2003) provide an example of using a computer-based simulation to teach students to locate items in a grocery store using aisle signs as guides to locate items that were not specifically written on the aisle signs (e.g. If the aisle sign said Cake Mixes, the students learned that they would also find brownie mixes on that aisle). Similarly, Wissick, Lloyd, and Kinzie, (1992) combined video models with computer-based instruction to decrease the number of error’s students made on a shopping trip. However, there is limited research on how computer-based instruction can enhance other classroom based practices.

Therefore, the purpose of this study is to examine use of computers and video as an addition to an on-going classroom based intervention to teach money skills that had not previously fostered generalization to the community. The focus of this study is on using computer and video technology to teach students to pay correctly for a purchase in a store using the dollar plus or dollar more strategy (Colyer & Collins, 1996; Denny & Test, 1995; Schloss, Kobza, & Alper, 1997; Test, Howell, Burkhart, & Beroth, 1993). Prior to this study all of the students had learned to make purchases to whole dollar amounts (e.g. $4.00) with some combination of in vivo and classroom based instruction. The students were engaged in classroom-based tabletop simulation activities that were not facilitating generalization to the community. The computer-based program used in this study was designed to teach students to pay for uneven dollar amounts on the computer, and through the use of video models, was designed to facilitate generalization to the community. Specifically, this study is a systematic replication of Ayres and Langone (2002), where video based models and a computer interface was employed to teach students the dollar plus strategy to a group of students who had no previous experience with making purchases of any amount. The present study incorporated certain changes designed to increase the chances that this group of students would be able to generalize the skills learned on the computer to in vivo activities. Results of the original study published in 2002 indicated that changes in computer interface were warranted. These changes would allow the learners to have a more realistic visual presentation of the stimuli and provide them more specific feedback for incorrect responses.

**Method**

**Participants**

Four middle school students diagnosed with intellectual disabilities participated in this study (see Table 1). All students were 14 years of age and served in a self-contained classroom in a rural middle school with six other students. Participants were selected based on inclusion of IEP goals related to purchasing skills. All students in the class participated in community-based skills twice per week. The teacher emphasized vocational skills on one day and shopping or leisure skills on the other day. During the shopping exercises the previous year, students had learned to pay for items that totaled to whole dollar amounts.

Adam a young man with Down Syndrome, was able to accurately follow verbal directions. He could read elementary text and would attempt unknown words by phonetically sounding them out (recent test data were not available). He could also perform simple addition and subtraction. Most of his IEP goals were focused on independent living skills (e.g., food preparation, job skills, and domestic skills). Socially, Adam was very adept and friendly. He enjoyed participating in computer activities and had past experience working on literacy programs via the computer.

Emily also had Down Syndrome. Academically she could read some sight words and do simple addition problems. Like Adam, she was very social and worked well with classmates and teachers. She also had experience working on the computer and most of her IEP goals were related to functional living skills as well. Emily had a medical condition that occasionally resulted in an interruption of the sessions to provide her with medication and rest.

James participated in a previous study conducted by Ayres and Langone (2002) under the same pseudonym. In that study, James made little progress on the computer-based
instruction and failed to generalize sufficiently to the community activities. He was diagnosed with Down Syndrome and an unquantifiable hearing loss in one ear. Academically, James was working on basic sight word reading and basic number skills. He had experience working with computer-based instruction and was reported to enjoy playing video games on the computer. Socially, James was a friendly and polite student who enjoyed engaging in conversation with peers and adults.

Arnold exhibited strengths in both receptive and expressive communication. Arnold had difficulty speaking clearly. His IEP focused mainly on daily living skills with some functional academics. According to teacher reports, he had difficulty sitting still for long periods but enjoyed working on the computer.

Settings and Materials

This study took place in two settings. The first setting was a large national grocery chain. Students participating in the study used a grocery store lane that was staffed by a trained confederate (i.e., third author and an undergraduate student in special education) playing the role of the cashier. Individually, students took baskets of food to the cashier and made their purchases. The entire checkout line system (scanner, total on the computer screen, receipt printer etc.) functioned as if the student were making a genuine purchase from a store employee. The grocery items that student’s used for purchases were pre-selected to represent various dollar totals from $1.01 to $9.99. Students also used a stack of 12 one-dollar bills for their purchases that they placed in their wallets.

The second setting in which part of the study took place was the self-contained classroom at the students’ middle school. The classroom measured approximately 15m × 20m with 2/3 of the classroom set up like a house (a kitchen, laundry area, living rooms, bathroom), 1/3 as a traditional classroom with desks and computers. A computer station was partitioned from the rest of the class and

### TABLE 1

Psychometric Description of Participants

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Stanford-Binet-IV</th>
<th>Vineland Adaptive Behavior Scales</th>
</tr>
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<td>Adam</td>
<td>14</td>
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<td>Composite: 58</td>
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<td></td>
<td></td>
<td>Verbal Reasoning: 70</td>
<td>Communication: 47</td>
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<td></td>
<td></td>
<td>Abstract Visual Reasoning: 48</td>
<td>Daily Living: 60</td>
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<td></td>
<td></td>
<td>Quantitative Reasoning: 60</td>
<td>Socialization: 74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Short Term Memory: 50</td>
<td></td>
</tr>
<tr>
<td>Emily</td>
<td>14</td>
<td>Composite: 58</td>
<td>Composite: 68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(No subscales available)</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Socialization: 86</td>
</tr>
<tr>
<td>James</td>
<td>14</td>
<td>Composite: 41</td>
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<td></td>
<td></td>
<td>Short Term Memory: 45</td>
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<tr>
<td>Arnold</td>
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<td>Composite: 38</td>
<td>Composite: 46</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Short Term Memory: 44</td>
<td></td>
</tr>
</tbody>
</table>

*StanfordBinet Intelligence Scale Fourth Edition (Thorndike, Hagen, & Sattler, 1986)
*Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984)
served as the location where students engaged in the computer-based probes as well as computer-based instruction. Students wore earphones while working on the computer to further reduce distractions for themselves and their classmates. In addition, students used a portion of the PROJECT SHOP CD-ROM (Langone, Clees, Rieber, & Matzko, 2003) specifically targeting purchasing skills (see Figure 1 for screen captures). PROJECT SHOP was a federally funded project focused on the development of a multimedia program to enhance and augment community-based instruction.

Response Definitions and Data Collection

The dependent variable was accuracy of response and was defined as a student beginning payment for an item within 5 s of the cashier announcing the total and completing the response by handing the cashier the correct amount of money (at least the stated amount but no more than $.99 over the stated amount) within 20 s of beginning the response chain. This response was scored as correct. If the student handed the cashier an incorrect dollar amount (too much or too little), or did not complete his or her response within 20 s of initiating payment, the response was scored as incorrect. If the student did not respond within 5 s of the cashier announcing the total, the response was recorded as a no-response error. Additionally, during community probes, the duration of student response was recorded. The timer began when the cashier announced the total and ended when the student turned his or her palm up to await their receipt and change.

During computer training, five different responses were recorded. An unprompted correct was scored when the student initiated a response within 5 s of the cashier announcing the total and accurately completed the re-

Figure 1. Screen capture of computer program.
sponse (i.e. paying at least the stated amount but no more than $.99 more than the stated amount) within 20 s of beginning the response. Differences in latency and duration requirements between the computer and in vivo were required to allow for reasonable interaction time with the computer interface. If the student began a response within 5 s and either did not pay the correct amount or took more than 20 s to complete a response, the trial was scored as an unprompted incorrect. If a student did not begin a response within 5 s and the computer prompted the student, the student had an additional 5 s to begin and complete a response. If the student completed the response accurately within 20 s of starting the response the trial was scored as a prompted correct. Similarly, if the student was prompted by the computer after not having responded for 5 s and he or she then initiated a response but failed to respond accurately or complete the response within 20 s, the response was scored as a prompted incorrect. Lastly, if the student did not initiate a response within 5 s of the computer delivering the $S^p$ and then did not respond when the computer made a prompt, the trial was scored as a no-response.

Procedure

*General procedures.* Students in this study already used the dollar plus strategy to purchase grocery items in classroom simulations and it was determined (i.e., through analysis of baseline data taken for this study) that the intervention was not successful at helping students to generalize to the community. The first step in the study was to determine the student’s present level of competence with the strategy in the community. After students demonstrated a stable baseline on community-based probes, both for accuracy of response as well as duration of response, students took part in computer-based probes. The classroom instruction (table-top simulations such as the teacher saying “You owe me $4.55” and the students responding by counting out $5) continued so that from baseline to intervention only a single variable was changed (the addition of the computer-based instruction). The computer-based probes were designed to evaluate student baseline performance with the computer-training tool. After stable baseline performances were achieved the first student began intervention. Once a student responded correctly and without a prompt to 80% of the trials during the computer-based training, all students in their received another community based probe to assess generalization for the student who reached the computer criterion and to monitor maturation of the other participants. Then the remaining students completed another set of computer-based probes and the next student began intervention. For the first students who achieved mastery on the computer-based probe, community-based probes were continued following intervention to monitor maintenance of treatment effects. An additional probe was conducted at the conclusion of the study in a store at a local shopping mall where students had never previously made a purchase, this allowed for some limited estimation of generalization across environments.

*Classroom based instruction.* Classroom instruction took place prior to the beginning of this study. The first community probes represent the degree to which this intervention allowed generalization of the behavior from the classroom to the community. To reduce the number of variables altered from baseline to intervention, all students continued to take part in this classroom based instruction. Students sat around a kidney shaped table, each with a stack of 12 one-dollar bills. The teacher sat in the middle of the kidney shaped table with a small cash register, her data collection forms, a stopwatch and pen. To keep students engaged, the teacher proceeded in a round robin fashion giving each student one trial at a time. The order moved predictably from left to right.

The teacher began sessions by keying a total into the cash register and turning the cash register toward the first student. She then said to the student “Your total is ________.” After announcing the total, the teacher placed her hand on the table in front of the student to await payment. The student was allowed 5 s to respond. If he or she responded correctly the teacher praised the student and gave them change and a receipt. If the student did not initiate a response within 5 s the teacher began to prompt the student. First the teacher would repeat the total and point to the total
on the cash register screen. If the student still did not respond, the teacher began to count aloud for the student to follow along while placing bills on the table. The teacher counted until she reached the dollar total (e.g., five for a total of $5.35), and then she said “and one more” to indicate that the student needed to place one more bill on the payment pile. Once a trial was complete the teacher moved to the next student; she continued around the table until all students had completed five trials.

Community-based probes. The purpose of the community-based probes was to allow students naturalistic opportunities to demonstrate their mastery of paying for grocery items, to monitor any generalization from the on-going classroom instruction, and to assess generalization of the behaviors demonstrated during computer-based instruction. Ideally, probes would have been conducted over several days with the student making actual purchases at stores. To generate adequate data this would have been logistically impossible based on school system resources to provide community-based instruction. Instead, similar to Ayres and Langone (2002), probes were staged in a community store. A confederate played the role of the cashier at the grocery store. Students were handed 12 one-dollar bills and told by the teacher to “Go to the cashier and pay for your groceries.” The cashier would ring up the groceries and announce the total following a randomized script to vary the verbal stimuli between possible presentations (e.g., “three dollars and thirty-four cents” and “five twenty-five”).

After announcing the total the cashier stood with his or her hands at their sides and waited 10 s for the student to begin a response. If the student did not respond, the teacher called the student back to the end of the line and the next trial began. If the student did begin a response, the cashier either held his or her hand out to receive the money (if the student paid to their hand) or waited passively with their hands at their sides (if the student paid the money on to the counter). In either case, when the student turned his or her palm up to wait for their change, the trial ended and the cashier handed the student change and a receipt. The student walked to the teacher with the change and receipt and the teacher handed the student another 12 one-dollar bills and told the student to go back and try again. The student was not told whether they responded correctly or incorrectly but was verbally praised for “working hard.” Students completed five trials per probe session and at least three probes were conducted for initial baseline. When two sessions were conducted on the same day, each session was separated by at least 30 min. Participants in the study not engaged in probes were elsewhere in the store with school staff working on other IEP objectives.

Computer-based probes. These probes were conducted on the classroom computer. The teacher instructed the student to sit down at the computer and told them that they would be practicing purchasing items like they do in the store. The teacher reminded the student to use the dollar plus strategy. When the program began, students clicked on the video in the bottom of the screen to pay another dollar. Each time they clicked the video, the hands in the video moved another dollar to the counter. When students were finished paying they clicked the closed wallet finish button to the right of the purchasing video. The computer allowed the student 5 s to begin a response and 20 s to complete the response. The students did not receive any feedback from the computer or teacher during these probes. Students completed 10 trials during each probe session and each block of probes lasted at least three sessions across at least two days until data were stable.

Computer-based instruction. During computer-based instruction, [CBI] students sat alone at the computer to work on the program. Each session consisted of 10 trials and the students engaged in one session per day separated by at least 1 hr. The layout and presentation were identical to probes except that the computer provided feedback for student response. Students were allowed 5 s to begin a response after the cashier announced the total. If the student did not begin a response in that amount of time the computer repeated the $^3$ and the trial was scored as a non-response error. If the student did begin a response but failed to finish the response within 20 s or did not hit the “finished but-
ton,” this was scored as an unprompted error, the computer provided descriptive feedback (e.g. “remember to click the finished button”), and the next trial began. If the student began and finished a response and paid either too much or too little, the computer provided corrective feedback in the form of specifically telling the student whether they paid too much or too little, the computer then demonstrated the correct way to pay and the student was given another opportunity to make the payment (this was still scored as an unprompted error but allowed the student to practice the correct response after watching a computer model). If the student still did not respond correctly, the computer guided the student through the correct response by highlighting places on the screen for the student to click to respond correctly thereby making certain that the student moved through the response chain. If the student responded correctly a video played of the cashier thanking the customer and handing the customer change and a receipt. The next trial began in a similar fashion.

Modifications. After Adam reached criterion on the computer he did not immediately generalize the acquired behavior to the in vivo setting. Two learning trials (including prompts) that exactly mirrored CBI were provided prior to session 43, and he was reminded, “to pay just like on the computer.”

Inter-observer reliability and procedural reliability. Inter-observer agreement and procedural reliability data were collected for the dependent measures during at least 33% of community-based probes for each student. The classroom teacher (fourth author) who held a masters degree in special education and had experience in single subject research, acted as reliability observers. They stood approximately 1 m away from the primary data collector, 3 m from the cash register but within range to hear and observe all student and cashier actions. The percentage of inter-observer agreement was calculated by dividing the total number of agreements by the sum of agreements and disagreements and multiplying by 100. Procedural reliability data were collected by following a protocol checklist where, for each trial, the observer marked whether the cashier engaged in the correct behavior. The total number of correct behaviors was divided by the total number of steps in the protocol and multiplied by 100 to compute a percentage of procedural reliability. Procedural reliability was 100%.

The computer tracked all data during computer sessions therefore it was not necessary to assess inter-observer reliability. However, to assess procedural reliability during computer-based instruction the teacher did one probe and one instructional session per week during which no problems occurred. No procedural reliability data were collected on classroom-based training because these procedures had been going on prior to this study and no student performance data were gathered either during these sessions either. This was deemed unnecessary because the primary concern was with generalization of the skill. Baseline probes were used to demonstrate the level of generalization.

Experimental Design

A multiple probe across participants design (Tawney & Gast, 1984) was used to evaluate the effects of intervention. The first student began intervention with subsequent students beginning additional probes and then intervention following as the first student reached criterion (improvement of 50% or more over baseline). This continued until all students had received intervention. After students met criterion, all students received community probes again.

Results

Figure 2 shows student performance from baseline to intervention for Adam and Emily and Figure 3 shows performance for James and Arnold. Closed circles represent the percentage of correct responses during community probes and the open triangles represent student responses on computer-based probes. The first student to receive intervention, Adam performed poorly during baseline in vivo probes. After 12 sessions on the computer he began to answer 100% of the computer-based probe questions correctly but he did not generalize the behavior to the community (Sessions 22-24). Following the single two trial training sessions in the community, between session 42 and 43, Adam immediately began
responding correctly to all trials in the community and continued to respond at high accurate rates for the remainder of the study.

Emily exhibited variable performance during baseline in vivo probes reaching a high of 100% correct for one session. Without being able to stabilize her performance, the choice was made to begin intervention. Following intervention, Emily’s community performance decreased from the baseline highs. Her work on the computer was equally variable.

James did not answer correctly during any of the baseline in vivo probes. Once he began intervention, he slowly began answering problems correctly on the computer. At his first opportunity to demonstrate the behavior in the community following intervention (Session 101), James answered 80% of the probes correctly and improved to 100% on the next two community probes.

During baseline in vivo probes, Arnold showed low variable responding. Upon introduction of intervention, he began responding accurately on the computer and this performance quickly generalized to the in vivo setting where he accurately responded to 60%, 40% and 60% of the probe questions correctly in his final community session.

Discussion

Based on visual analysis of the data, the program was effective at teaching the dollar plus purchasing strategy to three out of four participants and promoted generalization to the natural environment. The classroom teacher reported that the fourth participant, Emily, had difficulty controlling her medical condition during the study and the results appeared to be causing problems with her ability to concentrate in the classroom and on community skills. Normally, when this student is able to control her condition her attention and concentration are adequate to allow her to perform well in school. The overall impact of this program demonstrated positive effects for the other three students.

The remainder of this discussion considers two primary things. The first thing considered are the differences between the results from...
the Ayres and Langone (2002) study and the current investigation including some cautious suggestions about how these differences may have influenced the outcomes. Second, a more global discussion of how this study fits with the extant literature on community-based instruction and computer-based instruction and the directions the current results suggest for further research.

This study differed from Ayres and Langone (2002) in several ways that may have influenced the outcome. First, students participating in Ayres and Langone were significantly younger than those participating in the current study (mean age of participants in 2002 was 6.3 where as the mean age of the current study was 14). As might be indicated by their age, students in the present study also had significantly more experience in community-based instruction and this could have influenced their performance. In addition, during the present study, students received concurrent instruction in the classroom. Although these data show no evidence of this practice in the classroom directly improving student performance (note that student performance in the community did not improve until after computer-based instruction), it is possible that the additional practice in community environments may have influenced the outcomes.

A second difference from the Ayres and Langone (2002) study revolved around the instructional design of the computer-based instruction. In the 2002 study, the computer-based instruction taught the purchasing skills with a constant time delay procedure [CTD] (Wolery, Ault, & Doyle, 1991) with a video model as the controlling prompt and the computer provided general feedback for incorrect responses (e.g. "this amount is not right") before moving to the next trial. This does not mean to imply that CTD is an ineffective procedure to use in computer-based instruction, sufficient literature exists to support its use (e.g. Mechling & Gast, 2003). In the current study however, the computer did not use a
CTD procedure; rather if students made any error, the computer provided specific feedback (e.g. “You paid too much/too little). Then, the computer program provided a model of the correct response. If students still failed to answer correctly the computer guided the student through the response process by prompting with highlighted targets on the screen where the student would need to click. This made sure that students had to respond correctly before continuing to the next trial. By forcing students to make a correct response on each trial, the computer may have allowed the student the greater opportunity to learn the topography of the correct behavior.

A third design difference that separates this study from Ayres and Langone (2002) is the user interface. In that study, students saw a line of one-dollar bills across the bottom of the screen that they needed to click on to respond. Once a dollar had been clicked, the bill moved to the counter and was “used.” In the current study, the interface the students saw depicted a hand holding a stack of dollar bills over the counter. As the student clicked the hand, they saw video of the hand putting the bill on the counter. This perspective looked more like what a typical customer sees as he or she hands money to the cashier and may therefore, have possibly influenced generalization. We see this feature as a significant improvement over the interface created for the original study.

While the quality of computer-based instruction can and should be judged by the impact it has on a student’s behavior, designing effective programs requires isolating those features that are the most powerful and useful for students in learning. This program combined video models, and simple feedback to improve student performance. Further evaluation of other components though (e.g. pace of the models), complexity of feedback, explicit use of an errorless learning procedure (e.g. constant time delay) would provide software designers with more information to develop more powerful software. In addition, during the course of this study students were practicing the skills outside of the computer program. The degree to which genuine practice and simulated practice influence student outcomes requires further exploration. The integration of various modes of instruction may impact how rapidly students acquire the targeted skills.

In the final analysis, this study adds to the small, but growing literature that demonstrates that computer-based video models can be used effectively either with or without other simulations and community-based instruction to effectively teach functional skills. It appears that such instruction that uses technology can work with community-based activities to improve the efficiency of the instruction and possibly save time and other resources. Further research is needed to determine the best combination of video models with in vivo activities and also whether first person or third person models work best.

References


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