Math Peer Tutoring for Students with Specific Learning Disabilities

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Students with specific learning disabilities (LD) often have problems with mathematics that begin in elementary school and continue throughout their secondary years. For these students, growth in mathematics knowledge is estimated to be approximately one year for every two years of schooling (Cawley & Miller, 1989). Although hard data on the percentage of students with mathematics LD are unavailable (Bender, 1992), several researchers have reported that these students often lack even basic skill proficiency (Fleischner, Garnett, & Shepherd, 1982; Garnett & Fleischner, 1983; Thornton & Toohey, 1985). Specifically, McLeod and Armstrong (1982) suggested that high-school level students with LD perform mathematics operations at only the third- or fourth-grade level. Even after graduation from high school, challenges related to math continue to surface in the work place for these individuals (Scheid, 1990).

While some educators have suggested that an overhaul of the entire mathematics curriculum might be needed to improve skills (Smith, 1989), peer tutoring offers a less intrusive solution. A well-designed peer tutoring program provides directed repetition, regular review, and functional practice to overlearn skills, operations, and concepts (Lerner, 1993). Each of these areas is important to the development of fluent math skills.

Using Students as Math Tutors

Tutoring has been demonstrated to be effective with students of varying skill levels (Heron, Heward, Cooke, & Hill, 1983) and, of interest in this context, to produce specific improvement in mathematics (Barbetta & Heron, 1991; Franca, Kerr, Reitz, & Lambert, 1990; Greenfield & McNeil, 1987; Maher, 1984; Pigott, Fantuzzo, & Clement, 1986; Thurston & Dasta, 1990; Vacc & Cannon, 1991). Table 1 shows other reasons for using students as peer tutors.

Formats for Tutoring

Commonly used tutoring formats include peer (classwide), cross-age, 1:1, small group, and home-based tutoring (Miller, Barbetta, & Heron, 1994). Each of these formats is discussed briefly below.

Classwide peer tutoring. Classwide peer tutoring systems (CWPT) involve all students working in tutor-tutee pairs simultaneously (Carta, Greenwood, Dinwiddie, Kohler, & Delquadri, cited in Greenwood, 1991). As such, CWPT has been used to improve basic skill performance of low-achieving minority, disadvantaged, or students with LD within the general education classroom setting (Delquadri, Greenwood, Whorton, Carta, & Hall, 1986), and to increase the number of opportunities each student has to respond actively to academic materials (Greenwood, 1991).

Cross-aged tutoring. Cross-age tutoring is an effective method to provide individualized instruction (Schradj & Valus, 1990). In cross-age tutoring arrangements, the tutor is approximately two or more years older than the tutee and usually from the same school. In some cases, however, junior-high or high-school students from nearby campuses have served as tutors of elementary students (Barbetta, Miller, Peters, Heron, & Cochran, 1991).

One-to-one tutoring. Only select student dyads participate in this format. Usually students with LD needing remedial assistance work with just one other student, who serves as the tutor.

Small group instruction. Two procedural variations are possible within a small-group configuration. First, small-group tutoring may be used for students with LD who need additional (or remedial) practice with skills. Thus, part of their independent seat work time might be devoted to tutoring. In the second variation, the whole class participates, but on a rotating basis. While the teacher works with one instructional group, a second group is engaged in peer tutoring, while the rest of the class participates in independent seat work or other cooperative groups. Groups rotate daily (or weekly) to allow each group to engage in all activities.

Home-based tutoring. In home-based formats, parents (or siblings) serve as tutors. Although home-based tutoring programs have not been widely studied, preliminary data show that parents can serve as effective tutors for their children (Barbetta & Heron, 1991; Elksnin & Elksnin, 1991).

General Training Procedures

Tutors who have received specific tutor training have been found to emit more appropriate tutoring behaviors than untrained tutors (Greenwood, Carta, & Hall, 1988; Heward, Heron, Ellis, & Cooke, 1986). However, the procedures used to train tutors vary (Barbetta et al., 1991; Folio & Norman, 1981; Krouse, Gerber, & Kauffman, 1981). Generally, training is based on a task analysis of the tutoring role, with the steps trained sequentially. The extent and type of training relates directly to the goals and complexity of the tutoring task, and to the skill of the tutor.

In many tutoring programs, a model, lead, and test sequence is used (Barbetta & Heron, 1991; Barbetta et al., 1991; Cooke, Heron, & Heward, 1983; Heron et al., 1983; Maheady & Sainato, 1985; Polirstok & Greer, 1986). This sequence ensures that partners practice all elements of the program, including the critical element of error correction (Barbetta et al., 1991; Koury & Browder, 1986; Maheady & Harper, 1987). Further, it provides the teacher with a method for evaluating tutoring. Scripted lessons have also been used with this model to keep training consistent across groups and to cue trainer behaviors (e.g., Barbetta et al., 1991; Heron et al., 1983).

Once a tutoring program is implemented, it is important to monitor and evaluate the performance of both the tutor and tutee (Krouse et al., 1981). Daily and weekly progress data can be incorporated for this purpose (Heron et al., 1983). Performance probes can measure tutoring outcomes across time, while generalization measures assess effects across settings or responses (Stokes & Baer, 1977). Charts and graphs are efficient ways to gather and display data. In the following section, we take a closer look at implementing a math peer tutoring program.

Procedures for Implementing Math Peer Tutoring

Successful implementation of a math peer tutoring program involves three major steps: Getting ready, running the program, and enrichment and extension activities.

Step 1: Getting Ready

The first step, Getting Ready to Tutor, includes identifying the tutoring format to be used, selecting the tutoring pairs, training the partners, and arranging the environment.

Tutoring format. In determining which tutoring format to implement, teachers should take into account characteristics of students, resources available, and purpose(s) of tutoring. For example, if teachers wish to increase the level of active student responding, they may select classwide peer tutoring. Likewise, if they wish to increase opportunities for students to interact with students in other classrooms, they may choose a cross-age format.

Selecting partners. Student dyads can be paired by the teacher, either on a random basis (Kohler & Greenwood, 1990), by skill levels, or with special considerations for students with behavior or achievement problems (Cooke et al., 1983). Within tutoring pairs, students take turns administering instruction, each spending 5 to 10 minutes as the tutor.

Training tutors. In addition to the general training procedures described earlier, within this tutoring model, students must also be trained to use the tutoring folder. Thus, tutor-tutee pairs are taught to recognize the function of the "Go," "Stop," and "Star Card" pockets on the right side of the folder, and the tracking chart on the left side (see Figure 1). Further, they are taught how to use the X and O elements on the reverse side of the folder (see Figures 2 and 3). Folders are easily produced using a file folder, three library pockets, graph paper, and markers.

Arranging the environment. Arranging the environment requires attending to tutor scheduling, expectations, and the teacher's role. Tutoring can be implemented as little as once a week or as often as every day. However, a minimum of two to three days a week is recommended so that tutors and tutees can use trained behaviors readily. Tutoring typically lasts 30 minutes, with 20-minutes reserved for tutoring and 10 minutes for tests, reviews, and transition.

With respect to expectations, the teacher should provide clear and concise directions to students regarding their level of participation ("Do your best." "Help your partner."). Similarly, if math peer tutoring occurs outside the classroom (e.g., in the home), the teacher may wish to communicate these expectations to parents in writing. The teacher's role in tutoring is that of program developer, organizer, and monitor. In each of these roles, the teacher develops the actual content to be learned, arranges content sequentially as student performance dictates, and provides feedback and reinforcement to students regarding implementation of tutoring procedures and actual achievement.

Step 2: Running the Program

The second step in effective implementation of tutoring programs contains a sequence that can be used to implement, maintain, and evaluate peer tutoring across any of the formats described earlier.

Pretest. First, present a list of math facts (or concepts) to students, and ask them to solve them. Provide time for each response. The first 10 items that the student misses are used to develop his or her first set of flashcards. Second, conduct the pretest with a typical assessment protocol, that is, do not provide the student with any assistance in forming the correct response. After tutoring has been implemented and the student has mastered 10 flashcards, repeat the pretest procedure to obtain another list of 10 unknown items (e.g., facts, concepts).

Practice. Direct the tutor to take the math flashcards from the “Go” pocket and show them to his or her partner one at a time. Tutees should write (or say) the correct response. If the tutee responds correctly, tutors say “Good” and present the next card quickly. If the tutee makes an incorrect response or does not respond at all, tutors should first say, “Try again.” If after this prompt the tutee is still unable to produce the correct response, the tutor provides the correct answer. The tutee repeats the correct response. (This 2-part prompting procedure (i.e., Try again/Write or Say response has been an essential ingredient in previous tutoring programs). The tutor continues to present practice cards, reshuffling them until the time expires. After 2 to 5 minutes of practice and after testing, partners switch roles.

Test. Students turn their folders over to expose an O and an X (see Figure 2). The tutor shows each card once, holding it up for 2 to 3 seconds. If the tutee writes (or says) the response correctly, the card is placed on the O. If the tutee does not respond correctly, or makes no response, the card is placed on the X. No corrective feedback is provided. After all cards are presented, the back of each card is marked depending which pile the card was placed. Any card with three consecutive O’s moves to the “Stop” pocket. Cards without three consecutive O’s return to the “Go” pocket and they are practiced the next session. Once all cards are in the “Stop” pocket, they are removed from the folder and a new set of 10 cards is placed in the “Go” pocket. No new cards are added to the set until the tutee has mastered 10 flashcards in a set (i.e., all cards in a set have been moved to the “Stop” pocket).

Tracking Graph and Star Card. The tracking graph shows a record of the total number of cards mastered, and provides visual feedback and reinforcement to students (see Figure 1, left panel). Students mark the number of blocks corresponding to the number of cards that moved to the “Stop” pocket that day. By alternating colors daily, progress can be monitored. If no cards move on a given day, students draw a line between the connected boxes.

Maintenance Probes. Each time a set of cards moves to the “Stop” pocket, they are placed in an envelope and dated seven days ahead. On the date indicated, a review test is administered in addition to the daily test. If a maintenance card is identified correctly, it exits the system. If a maintenance card is identified incorrectly, however, it is placed with the next set of flashcards to be inserted in the “Go” pocket (9 new cards plus 1 card from the failed maintenance probe). In short, a card exits the system only if it is identified correctly three consecutive times during daily testing and once during maintenance testing. Maintenance is essential to ensure retention of skills learned previously.

Step 3: Enrichment and Extension.

Supplemental practice provides enrichment and extension activities related to tutoring content. For example, if the students practiced math facts, they might use word or application problems during generalization exercises. Formulae, time, money, fractions, measurement, conversions, estimation, and many other skills can be included within an extension program. Teachers are reminded to watch for opportunities where a fact, application, or concept can be included or extended. This procedure serves as a good review and facilitates generalization to new situations.

Program adaptations can enrich or extend skills by varying the type of cards available in the "Go" pocket, or the type of responses expected from students. Figure 4 shows a sample of adaptations that may be used across math applications and grade levels. Individualization can be further adapted by creating different card sets based on student ability, adjusting the pace of tutoring, or varying the number of cards per set.

Conclusion

Teachers must recognize that peer tutoring is not an "add on" program. Instead, it is an instructional methodology that is consistent with most teacher goals. It provides the opportunity for students with LD to become active learners and offers a functional way for students to learn mathematics skills. Teachers can manage a tutoring program in the same way that they manage other small-group activities in their classrooms. In fact, given the structured nature of tutoring programs, student management concerns are reduced.

Special materials preparation can be minimized by having students prepare stimulus cards, or by enlisting the aid of parent volunteers. Students only need enough materials to initiate the program. Replacements can be generated during implementation.

Some teachers might be opposed to tutoring on philosophical grounds, believing that all instruction should be delivered directly by them. Although, teachers should be skeptical, a healthy skepticism should not be confused with bias. Given the overwhelming data demonstrating the effectiveness of tutoring programs for all students, especially those with LD, even the most hesitant practitioner should concede its efficacy and provide implementation opportunities consistent with student needs.

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Table 1. Reasons to Use Students as Tutors

- Peers can “shape” the behaviors of others (students, teachers, and parents) (Gerber & Kauffman, 1981; Greenwood, 1981).
- Peers have been shown to be effective teachers (Cooke, Heron, & Heward, 1983; Gerber & Kauffman, 1981).
- Peer interventions can increase the chances for success of students with LD in mainstream activities (Heron, Heward, Cooke, & Hill, 1983; Madden & Slavin, 1983).
- Peer tutoring programs can avoid stimulus control problems that may arise when one or only a few individuals administer contingencies (Cooper, Heron, & Heward, 1987).
- When peers are used as behavior change agents, the desired student behavior may be performed across a wider variety of settings and situations (Anderson-Inman, Walker, & Purcell, 1984; Goldstein & Wickstrom, 1986).

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Figure 1. Sample Tutering Folder and Left Inside Panels

Sample tutoring folder showing right and left inside panels. The shaded area shows the number of cards that moved from the "Go" pocket to the "Stop"pocket on a given day. Hortizontal lines through the boxes indicate that no cards moved that day. In this example, four cards moved on day 1, zero on day 2 (indicated by the horizontal line between connected boxes), 4 on day 3, and so forth. Numbers within the tracking box show cumuative progress (17 have moved to date).

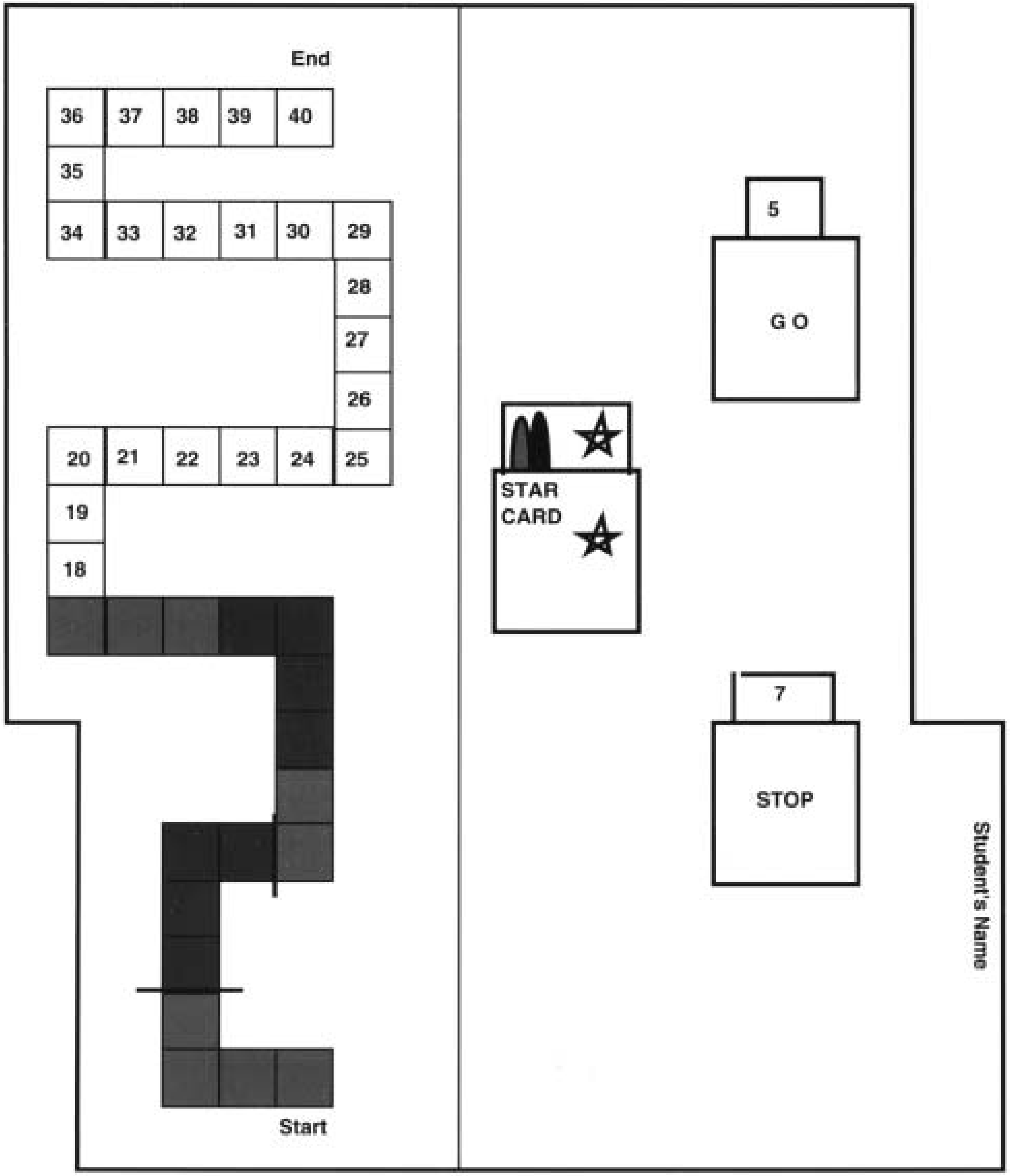

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Figure 2. Back of a Folder Showing the Location for a Correct Response during Testing (O), and an Incorrect Response (X) during Testing.

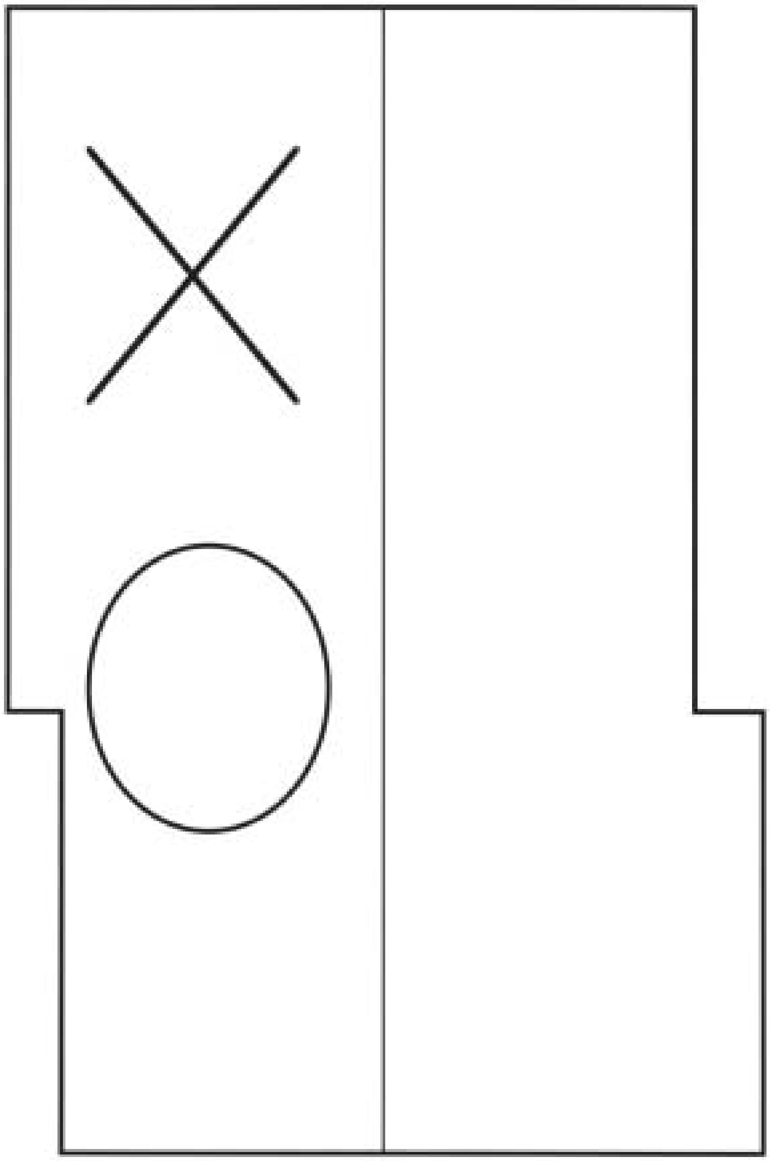

Figure 3. Sample Tutoring Folder

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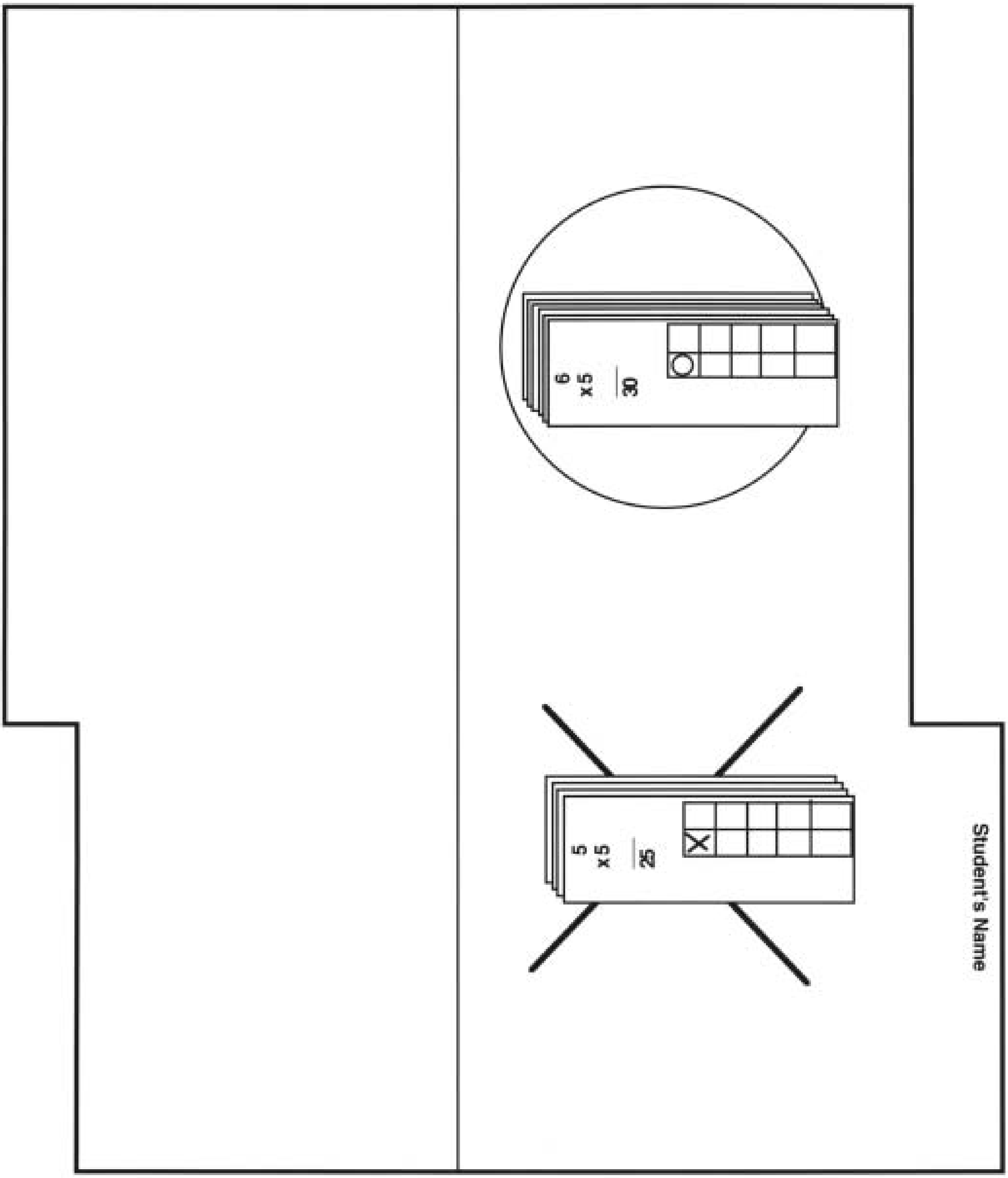

This is a sample tutoring folder (reverse view) showing cards that have been placed on the O (correct) box, or X (incorrect) box. Individual cards are marked with their respective outcomes.

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Figure 4. Flashcard Variations

Sample adaptation cards showing (a) a range of skills, concepts, and applications for math; and (b) possible stimulus or response alternatives. Each card represents 10 such cards that would be placed in the "Go" pocket.