Response Cards: A proven method for producing active student engagement during math instruction

Ennio Cipani

National University- Fresno Campus

10/05/07

Abstract

This article presents an instructional delivery method, termed response cards, that has received empirical validation in several studies. With various federal and state mandates and measures of accountability, schools are under increasing pressure to use methods that have received validation of their effectiveness in research studies. Response Cards can be incorporated with almost any elementary or secondary grade math curriculum series. It has several distinct advantages for teachers, including in-situ assessment as well as the ability to alter the instructional presentation as a function of student learning.

Response Cards: A proven method for producing active student engagement during math instruction

Educators know that active learner engagement in the lesson produces greater and faster acquisition of the skill/concept being taught (Rosenshine & Berliner, 1978). Active learner engagement is a desirable outcome, but how is it achieved? How does a math teacher get students actively engaged during the instructional presentation? In the beginning elementary grades, student engagement is often observed in unison responding activities. For example, teaching first graders how to sound out the first letter of the word presented on a surface that everyone can see, is often accomplished by the teacher demonstrating and then evoking class unison responding, e.g., “everyone say, “m” (drawn out sound). “Good, now look at this word and sound it out, Mmm ouse.” Unison responding is a technique many early elementary school teachers use effectively to get students engaged. But how can unision responding apply to the teaching of math skills? The same unison effect can be achieved with an instructional process termed response cards (Cipani, 2008).

Research evidence for response cards

Research testing the efficacy of response cards has found positive results to student achievement as well as student behavior in a number of studies (Armendariz & Umbreit, 1999; Cavanaugh, Heward, & Donelson, 1996; Davis & O’Neill, 2004; Heward, Gardner, Cavanugh, Courson, Grossi, & Barbetta, 1996; Lambert, Cartledge,

Heward, & Lo, 2006; Narayan, Heward, Gardner, Courson, & Omness, 1990). Empirically validated research methods are touted by Federal Legislation (No Child Left Behind Act, or NCLB) as requisites for instruction in content areas. Response cards has been empirically tested since the Narayan et al., (1990) study, in varying content areas over differing grade levels and has been demonstrated to be more effective than other more traditional methods of instructional delivery.

In the Narayan et al., (1990) study, hand raising (HR) was compared against response cards (RC) on daily quiz grades in a social studies period in a fourth grade class. In the HR condition, the teacher would ask a question and then call on someone who had their hand raised. The teacher would indicate whether the student's answer was right or wrong, and then proceed with more instruction or ask another question. In the RC condition, all students responded to the teacher's question by writing their answer on their dry erase card and holding it up upon the command, "Ready, show! "The mean quiz grades fort the first hand raising (HR) condition was 73%. The mean quiz grade for the first response cards (RC) condition was 82%, almost a ten point increase in grades!

The same effect for response cards has been demonstrated in elementary grade math. A study conducted with 24 ethnically diverse students in an elementary grade class during math instruction compared hand-raising against response cards on several achievement measures (Christle & Schuster, 2003). The teacher for the class had 27 years of teaching experience. The school is located in an urban setting, with overall test scores on the California Test of Basic Skills (CTBS) of 44.8, below that of the state mean of 52.5.

The classroom setup had students' desks in columns and rows facing the blackboard. Math instruction occurred between 10 and 11 in the morning, with several instructional activities planned during that time, e.g., homework review, timed trials using a sheet of math problems, presenting new material and guided practice over new material. It was during these latter two instructional activities that the HR and RC conditions were deployed. The HR and RC conditions replicated the same procedures delineated in the Narayan et al., (1990). study.

Two dependent measures were taken in this research study: (1) student on-task behavior and (2) daily quiz grades on the covered material. Observers recorded on-task behavior for 5 target children whom the teacher considered to be representative of the class. Both these measures were collected during the HR condition and the RC condition each day.

All five students being tracked for research study purposes showed some differences between the HR and RC conditions in test scores. Three of the five students showed significant differences. In the case of Brad, during HR, he did not raise his hand once. In contrast, across 5 RC sessions, he wrote on his card an average of 97% of the total opportunities (i.e., responses to teacher questions). And the extra effort/work on his part was worth it! The difference in his mean daily quiz grades was equally dramatic: 63% during HR vs. 93% during RC. Similarly his on–task was also improved significantly, from a mean of 12.5% during HR vs 100% during RC. While all students improved their response opportunity on RC, two students did not seem to require such an instructional method, since the quiz grades did not differ substantially under either condition (lowest grade score was 87% in the HR 1 condition)

How does response cards provide a solution for math teachers?

The following advantages accrue to a math classroom using response cards as a method for delivering math instruction (Table 1).

(insert Table 1 here)

In situ assessment. A major advantage of this technique is that the teacher will be more "in tune" with all the students' progress. The teacher will quickly discover which students are learning the skill or concept being taught and which students are in need of additional, more focused teaching. This is termed in-situ (in-situation) assessment. The table below illustrates the use of response cards in a hypothetical second grade class (Table 2).

(insert Table 2 here)

What did the in-situ assessment reveal? Some students need to attend better while copying down the correct numbers. Other students may need more guided practice on placing the ones column answer in the correct column. The teacher can adjust her instructional strategy as a function of this information. The example in Table 3 for another second grade class illustrates what might happen when response cards are not used.

(insert Table 3 here)

What is the difference between classroom A and classroom B? In classroom A, the teacher becomes aware of which children are able to perform the target skill correctly before handing out an assignment. In classroom B, error patterns are not detected until later (if at all, until the unit test). This teacher is unable to adjust his/her instruction to meet the needs of the students during the lesson. In class A, the teacher is "in tune" with who is getting it and who needs more practice. If a fair number of students are making the same mistake, possibly a few more well explained demonstrations are needed.

Produce greater levels of attention and skill acquisition. The research cited above on response cards has shown such effects. Using response cards requires constant student attention to the instructional lesson. Every few seconds, the students are required to demonstrate their knowledge, hence they will be actively engaged in the short instructional presentation since they know they are going to be asked to perform and show their work.

Able to adjust instructional presentation "on the spot." As a result of the on-going, in-situ assessment function built into the response cards instructional delivery, the teacher can make adjustments to the lesson presentation to address student deficiencies. Response cards truly make the teacher "get in touch" with the learner's performance across all the students in the class. The example below illustrates how such information can be used to adapt the lesson presentation on the spot for a hypothetical fifth grade class (see Table 4).

(insert Table 4 here)

Note that the adjustment the teacher makes, ***while conducting the lesson***, was the result of her observing that the students were unable to perform the series of steps required to add mixed numbers. She subsequently reduced the lesson demonstration to the first part of the process, finding the least common denominator with just simple fractions, and adding them. Once the students master that skill, she will add to that the conversion of a mixed number into an improper fraction in an accurate and fluent level. When the students are able to perform both of these skills, she can then proceed to have them learn how to perform the whole enchilada, possibly still within the length of time this lesson was scheduled to present. When you use response cards this ability to alter instruction is existent. If you did not use response cards, can you determine if the instructional presentation needs to be altered?

Variations in use of response cards

Traditional Method. During response cards rehearsal, the teacher presents each item one at a time. In the early elementary grades, the student writes down the problem and the answer, so that the teacher can determine where and why errors are occurring. In the older grades, the students can view the item and then each student writes their answer on their individual response cards. Since the teacher must view all students' response cards, it may be wise to have the students write down just the answer on the response card. These students may need to have a scratch paper to calculate their answers, and then place their answer on the response card.

Peer tutoring (Respond in Pairs): Especially with larger classes, you may want to pair up students, which will also provide an opportunity for peer tutoring (depending on how you pair up students). By pairing up the students, you would need to have only half the number of response cards for the class, e.g., a class of 30 would only need 15 response cards. The same procedures as delineated above are in effect, except the students work on the problem in pairs and then one answer is written on the response card.

Particularly for students in the class who need guided practice, responding in pairs can provide a significant instructional advantage. The disadvantage is that you may not be sure if the less capable student of the pair is learning. To control for that, the teacher can periodically present a single test trial that half the students respond to and then another test trial where the other half of the students respond to without help from their partner. The teacher can then judge if further teaching/practice on the objective is necessary.

Response Cards: True/false responding. For some items, especially conceptual problems, a true-false response mode can be used. You can present the items in a true/false manner by giving each student two pieces of construction paper; one blue colored paper and one white paper. The blue color construction paper could signify a true response to the item by the student ("rue blue"). You can have the students write "true" on it to remember that this card is held up when they want to respond with "true." The white color paper should signify a false response (they should write false on it). When you present the item, the students respond either "true" or "false" by holding up one of

the colored papers. Using these two colors for the student response cards will allow you to scan many students and determine quickly who is responding correctly

Summary

Response cards, an empirically validated procedure, can be incorporated into almost any elementary grade math curriculum series. Test items can be presented in several different formats allowing for in-situ assessment of a variety of skills, ranging from basic to advanced conceptual skills. Due to the in-situ assessment function, it can be used by math teachers to alter the instructional presentation as a result of students' performance on targeted skills. It is an essential tool in math instruction to address the needs of all students in the class.

References

Armendariz, F. & Umbreit, J. (1999). Using active responding to reduce disruptive behavior in a general education class. Journal of Positive Behavioral Interventions. 1, 152-158.

Cavanugh, R.A., Heward, W. I., & Donelson, F. (1996). Effects of response cards during lesson closure on the academic performance of secondary students in an earth science class. Journal of Applied Behavior Analysis, 29, 403-405.

Christie, C.A. & Schuster, J.W. (2003). The effects of using response cards on student participation, academic achievement, and on-task behavior during whole-class, math instruction. Journal of Behavioral Education. 12, 147-165.

Cipani, E. (2008). Classroom management for all teachers: Plans for evidence-based practice (3rd edition). Columbus, Ohio: Prentice Hall.

Davis, L., & O'Neill, R.E. (2004). Use of response cards with a group of students with learning disabilities including those for whom English is a second language. Journal of Applied behavior Analysis, 37, 219-222.

Lambert, M.C., Cartledge, G., Heward, W.L., Lo, Y. (2006). Effects of response cards on disruptive behavior and academic responding during math lessons by fourth grade urban students. Journal of Positive Behavioral Interventions. 8, 88-99.

Narayan, J.S., Heward, W.L., Gardner, R.I., Courson, F.H., Omness, C.K. (1990). Using response cards to increase student participation in an elementary classroom. Journal of Applied Behavior Aanlysis. 23, 483-490.

Heward, W.L., Gardner, R.I., Cavanugh, R.A., Courson, F.H., Grossi, T.A., & Barbetta, P.M. 1996). Everyone participates in this class: Using response cards to increase active student responses. Teaching Exceptional Children, 28, 4-11.

Rosenshine, B., & Berliner, D.C. (1978). Academic engaged time. British Journal of Teacher Education, 4, 3-16.

Table 1: Benefits of Response Cards

Instructional procedure

- Provides an in-situ assessment across all students in the class on the current curriculum is available to teacher
- Response cards format produces greater levels of attention during lesson presentation and greater skill acquisition
- Response cards format allows the teacher to adjust his/her instruction each lesson as a function of student responsivity to the lesson presentation

Table 2: Hypothetical Class A.

Teacher: OK class, let me show you how to add two numbers that both have two digits. Watch how I keep my answers in the right columns. Here is a problem 23 + 34 = . I start by adding the numbers in the ones column. 3 + 4 = 7, I place the answer here directly under the ones column. I can now add the tens column numbers, 2 + 4 = 6 and place it directly under the tens column. The answer is 67. Let me show you another one (teacher would demonstrate 1-2 more examples on her white card.

Teacher: OK, everyone pick up your dry erase card. Your turn to practice. Let's add 16 + 51 = (teacher would write this on her card). OK everyone copy this problem and stop there.

Class: (students copy down that problem)

Teacher: Ready show! (Teacher surveys the students response cards and spots a few students who copied one or more digits wrong) Let's check our work. Danny, Barry and Surrie, look at what you have written and see where you made a mistake copying down the problem. Erase yours and re-copy this problem down.

Teacher: OK class now add the numbers in the ones column only. (waits a short time for students to add these numbers). OK Ready , Show. (Teacher surveys response cards for all students noting who is adding correctly, paying attention to the placement of numbers in the correct column. Teacher sees that some students have placed the ones column answer under the tens column. She begins to devise a method for getting these students to learn how to place the ones answer in the

ones column). OK class, some of you are not placing the answer in the correct column. Let us erase our answers only and add that again. This time I want you to add the 6 and the 1 only and place it here. I have drawn a line on my response card. Does everyone see where the line is? That is where you should place your answer. (Teacher would then guide them through this two step process, making sure answers get in the right columns)

Table 3: Hypothetical Class B.

Teacher: OK class, let me show you how to add two numbers that both have two digits. All eyes on the card! Watch how I keep my answers in the right columns. Here is a problem 23 + 34 = . I start by adding the numbers in the ones column. 3 + 4 = 7, I place the answer here directly under the ones column. Sarah, Please pay attention. You will not learn this if you are looking out the window while I demonstrate. Ok let's get back on track. I can now add the tens column numbers, 2 + 4 = 6 and place it directly under the tens column. The answer is 67. Let me show you another one (teacher would demonstrate 1-2 more examples on her white card.

Teacher: OK, does everyone understand how to do this? If you don't understand let me know now. I don't see any hands? Good. OK, now that everyone knows how to add these numbers, you going to practice answering these types of addition problems. Teacher passes out a sheet of math problems with 2 digit addition without carry.

Class: Students work on the practice sheet and turn it in when completed. Upon examination there is sufficient evidence that not all students are capable of performing this procedure for adding two digit numbers. Some students place the ones answer in the tens column, while placing the tens column answer in the ones column. Some students have the right answer but the answers are not under the columns (which will be a problem when dealing with carry to tens, hundreds place addition).

Table 4:. Teacher adjusting lesson presentation

Teacher: OK class, let me show you how to add mixed numbers with unlike denominators. Here is a mixed number 3 ¼. Writes that number on response card. Let's add another mixed number to that, 5 and 2/6. We first convert the fractions in each number to a lowest common denominator, that being 12ths. Now what is 3 and ¼ converted to 12ths equal? Yes. 39/12 ths. Now we do the same for the other mixed number, and we come up with 66/12 ths. We can now add these two together to arrive at our answer which is 105/12, when we simplify this improper fraction back to a mixed number we get 8 and 9/12 ths or 8 ¾. OK now you try one. Get out your response cards. I want you to add 5 ½ to 3 and 2/3. Write on your scratch paper and then write your final answer on your response card.

Class: students copy down that problem on scratch paper and after about a minute teacher asks the to show their answers. Almost everyone missed the correct answer.

Teacher: (senses that the students did not fully grasp all the steps of this complex set of operations decides to break it down. OK, Let's do just the first part of this problem, deriving the common denominator for unlike fractions. Let's add ¼ and 2/6 ths. We first convert the fractions to a lowest common denominator, that being 12ths. Now we convert each fraction to its equivalent in 12ths. Watch while I show you the process again. (Teacher demonstrates process on ¼ and 2/6ths.) OK your turn, try these two fractions, writing 1/3 + 2/5 on her response card. (proceeds to give students about half a minute to solve that problem).

Implementation Guidelines

To use the response cards method during math class, you must first identify the daily content and the chunk of material to be presented. For each chunk of material that will be followed by response boards practice, you should identify the objective(s) and corresponding practice items. Make sure that the pre-requisites are developed, and that the math curriculum is inherently hierarchical in the sequence of skills to be developed. When this front-end work is completed you can then begin to conduct this instructional procedure in the classroom. Give each student a dry erase board and a dry erase pen. Present the lesson (chunk of material) or the class assignment. Subsequent to the lesson presentation, present the practice items until the majority of the students are demonstrating mastery of the objective(s). The table below delineates the actual procedure in conducting response boards practice sessions.

Response Boards Procedures

1. Present one item
2. Give the students a few seconds to write their answers on their dry erase boards
3. Signal them to show their answers.
4. Scan the class, praising students (a few) who gave the correct answer and present the correct answer to the class.
5. If several students made errors, go over the process for the correct response to that item

6. Present the same item again.
7. Present additional items until the majority of students demonstrate competency or the group's performance indicates more instruction is needed