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ABSTRACT

The needs of the teacher who seeks successful practical action are different from the needs of the scientist seeking truth. Distinctions made in action science bring out this difference. Action science emphasizes an integration of personal knowledge and social discourse along with objective data in cycles of planning, acting, and fact-finding about the results of the action. Practical ways for teachers to implement these features are discussed. In particular, methods of making it easier to obtain objective data by means of self-recording are presented in some detail. Two examples of field projects in the first grade mathematics illustrate how this works. (The first example presents a record that justifies keeping and repeating one of the teachers' strategies. The second example presents a record that indicates a change was needed and how the change turned out.) (Author/YP)

Improving Instruction With Self-recording and Discussion:

Action Science in the First Grade

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Running head: IMPROVING INSTRUCTION

Abstract

The needs of the teacher who seeks successful practical action are different from the needs of the scientist seeking truth. Distinctions made in action science bring out this difference. Action science emphasizes an integration of personal knowledge and social discourse along with objective data in cycles of planning, acting, and fact-finding about the results of the action. Practical ways for teachers to implement these features are discussed. In particular, methods of making it easier to obtain objective data by means of self-recording are presented in some detail. Two examples of field projects in the first grade illustrate how this works.

Improving Instruction with Self-recording and Discussion: Action Science in the First Grade

In contrast to the theoretical scientist whose primary goal is knowledge of the way things are, the primary goal of practicing teachers is knowing how to do things. Teachers want to know how they can help their students to learn. They want to know how to do this for particlar students in a particular class. To obtain this practical knowledge, teachers have apprenticeship training in student teaching and on-the-job experience. What works for one teacher may also be shared with other teachers in workshops and methods courses. Although knowledge about successful actions can never be a complete substitute for actually performing those actions, knowledge about actions, like any other science, can contribute to successful practice. In this respect action science has particular relevance for practitioners such as teachers. Action science, however, makes its contribution to advancing effective practice with methods that are different from the methods of controlled experimentation for advancing scientific theory.

Argyris, Putnam and Smith (1985), for example, contrast the methods of action science with those of controlled experimentation:

> We may say that experimentation is a subset or a refinement of action, one in which practical interests are bracketed for the sake of precise explanation. For example, the experimenter is frequently enjoined to control all relevant variables and to vary but one at a

> time. Practical action occurs in a field of multiple and interacting variables, and the agent usually does not have unilateral control over them. The methodology of experimentation allows the experimenter to determine whether situations confronting subjects are the same. In the action context, it is the interpretations of actors that are critical to determining if two situations are the same. An experiment occurs, in a sense, outside of history. But in action science, perhaps the most important consequences of any inquiry are their impact on the rules and norms that will guide future inquiry in that same community of practice. (p. 64)

In a sense, traditional science streamlines inquiry by separating each variable of interest from contextual complexities in order tc refine the explanations of the scientific community. In contrast, action science directly engages contextual complexities in advancing effective action by practitioners.

In early efforts to develop action research in education during the 1950s, these distinctions about methods were not fully developed. The primary attention was directed toward group dynamics, which fit in nicely with progressive education's historic search for community (Clifford. 1973). A secondary consideration went toward using scientific methods in a somewhat uncritical way. A closer look, however, would have indicated that, without modification, the methods of science were inappropriate for the teacher as practitioner. Dewey (1922), for instance, had suggested that engineering was more fundamental to teaching than science. Not surprisingly, an early evaluation of the action research enterprise in terms of scientific method was largely negative (Hodgkinson, 1957). For some people, this left action research with a reputation as a relatively subjective enterprise of personal knowledge and social discourse without much concern for objective data.

This is unfortunate because the need for an integration of both subjective and objective influences on action was recognized in the original formulation of action research. Kurt Lewin (1958), who is credited with introducing the term action research and establishing some of the benefits of social discourse, describes "a spiral of steps each of which is composed of a circle of planning, action, and fact-finding about the results of the action" (p. 201). This approach requires objective fact-finding as well as social discourse: "In a field that lacks objective standards of achievement, no learning can take place. If we cannot judge whether an action has led forward or backward, if we have no criteria for evaluating the relation between effort and achievement, there is nothing to prevent us from coming to the wrong conclusions" (p. 201).

The problem for action research in education has been in determining what the fact-finding should be. If we look at the objective information that guides practitioners, whether they are artists, craftsmen, or technologists, we see that they rely heavily upon ongoing feedback from their activities. Some of this feedback is naturally built in, but more formal measures are commonly used to supplement deficiencies in natural feedback. When we look at teaching, however, we see that natural feedback and supplementary measures are often deficient. Teachers typically have little built-in feedback on how well their students are learning. Furthermore, formal objective information on what students have learned is much less than it might be..

Although the cost in maintaining daily records may be prohibitive when the teacher does all the record keeping, this cost can be avoided by relying on student self-recording. The primary purpose of this paper is to show how this self-recording can provide much if not all of the objective data that is needed by teachers. When coupled to personal knowledge and social discourse, this method of obtaining data allows a practical implementation of action science .

Self-recording by students has a long history that dates back at least to the early part of the century although without the emphasis on discussion and cooperative relationships that we are advancing here (see Bobbitt, 1913; Dvorak, Merrick, Dealey, & Ford, 1936; O'Brien, 1926; Washburne, 1922). Since then, the advocacy and implementation of self-recording has continued to be advanced with generally favorable support from the research literature (cf. Mclaughlin 1976; O'Leary & Dubey 1979; Rosenbaum & Drabman, 1979; Studwell & Moxley, 1984; Van Houten, 1984).

In general, records should be selected on the basis of their relationship to what is important in the curriculum. Personal knowledge and social discourse can make substantial contributions to this selection. A good record should then show (1) what was done, (2) when it was done, and (3) allow an opportunity for change to occur. The opportunity for a change to occur may be broken down into three further components: a) There must be at least one comparison of what the child could do at a different time. More comparisons are often desirable but we need at least one for any possibility of showing change. b) The task should not be too diff cult. The record presents a problem if the child cannot show some success and some improvement. And c) the child should have a realistic opportunity to do more than what was done. If we want to teach a child to count to twenty, we do not know if a child already knows how to count to twenty if we only allow the child to count to five when we begin. We want to find out how far the child can count (or do any other task we plan to teach) from the beginning. Under these guidelines, even collections of children's drawings, dated and collected with a count of the details in the drawings, can be a good record.

Virtually any record the teacher selects can be a good place to start as long as the teacher has a basis for changing to a better record. What the teacher needs is a reasonable suggestion for making a change and a reasonable judgment for continuing or discontinuing that change. When there are frequent feedback cycles, the criterion level for taking practical action need not be nearly as high as the level of acceptability for making confident statements in traditional research. Indeed, the methods of traditional research entail requirements which prohibit a teacher's use of these methods in frequent feedback cycles over time, and it is doubtful that the sacrifice of feedback for more confident theoretical statements would be a good trade-off for teacher practitioners.

When there is frequent feedback on progress, like driving a car or riding a bike, we have little need of a scientific explanation to guide our actions. Instead we get frequent indications of movements that take us closer or further away from where we want to go. And, indeed, effective action would be crippled if we had to wait upon a scientific guarantee before we made the next turn of the wheel. Scientific rules, guidelines, and plans are essential when we lack effective feedback, but they are never a completely adequate substitute for that feedback. Important as feedback is in our everyday activities, it is such a common occurrence that, like the air we breathe, we take it for granted. It is instructive, for example, that it took a much later reanalysis of the data from the Hawthorne Studies before it was realized that the "puzzling" Hawthorne Effect was essentially a feedback effect in which the incidental addition of consequences brought improvements in performance (Parsons, 1974).

Once frequent self-recording is in place, improvements in student performance suggest that the teacher keep and repeat the instructional changes that were followed by those improvements. Failures to improve call for a new action by the teacher. The records do not necessarily tell the teacher what action to take when a change is needed (personal knowledge and social discourse must be relied on here). But the records will subsequently show the teacher the results of the action taken. If improvements result, keep the action, if not, try another way.

Over time, with frequent feedback cycles and a community of discussion, it is reasonable to expect the same success in improving instruction as other feedback systems provide for other endeavors.

The following examples illustrate two different record situations for teacher action. As such they exemplify a method for effective action rather than a method for making confident statements on causal relationships. The first example, by the second author, shows a record that justifies keeping and repeating one of the teacher's strategies. In this project there were weekly discussions that involved the college instructor, the teacher, and the teacher's peers in large and small group interactions. The second example, by the third author, shows a record that indicates a change is needed and how the change turned out. This project was conducted as an independent study in which there was only one additional conference between the instructor and the teacher after the beginning and before the end of the project.

Both of these projects are in math, which is a good place to begin a classroom-wide system of self-recording since 1) initial indicators of progress can be readily derived from the curriculum guides, and 2) the activity of self-recording easily fits into the curriculum content. Graphing by young children, for example, is frequently recommended as a way of introducing basic math concepts (Aho, Barnett, Judd, & Young, 1976; Baratta-Lorton, 1976; Bruni & Silverman, 1975; Christopher, 1982; Nibbelink, 1982). Graphing by students has also been recommended as a means of feedback and motivation in developing math skills (Fink and Carnine, 1975; Miller, 1983).

EXAMPLE 1

In the following project by the second author, twenty first grade students demonstrated and graphed their progress toward the objectives stated in the Heath mathematics text (Rucker & Dilley, 1981):

1. Given an analogue clock face showing time at the hour and at 1/2 past the hour, the child will be able to verbally state the time and write it in digital form.
2. Given addition problems with sums up to 11 and 12, the child will be able to correctly complete the problems in written form.
3. Given substraction problems from up to 11 and 12, the child will be able to correctly complete problems in written form.
4. Given 4 geometric shapes (circle, square, rectangle, and triangle), the child will be able to verbally label the shapes.
5. Given an object less than 12 inches in length, the child will be able to measure it and record the measurement to the nearest inch.
6. Given an object less than 20 centimeters in length, the child will be able to measure it and record measurement to the nearest centimeter.
7. Given addition and subtraction problems up to 13, the child will be able to correctly complete the problems in written form.

The children used slash marks [/] when work was started on a particular skill, x's [X] when progress was made, and a stamp when at least 80% accuracy was achieved. See Figure 1. Each recording was made in individual booklets, dated, and followed up with daily practice in individualized "work packets". This work was checked each day by the teacher. The students soon developed a sense of accomplishment in their individual checklists, which was illustrated by their willingness to share their graphs with other students. Few examples of competitiveness were observed.

Insert Figure 1 about here

In addition to the student graphs, the teacher kept her own graphs to monitor student progress. After the children had graphed their individual progress, the teacher graphed the number of students in the class who had achieved mastery. The teacher also graphed the changes in instruction after they were written in her daily log of changes made and observed. Figure 2 is a composite of changes in student achievement and changes made by the teacher. These were originally kept on separate graphs. The top half of Figure 2 shows the number of students who achieved mastery in each objective. The bottom half of Figure 2 shows the type of change made by the teacher. These are recorded with letter codes in columns beneath the dates. A = a change in the antecedent conditions; C = a change in the consequences. These were the only two categories originally designated on the teacher's graph. The new categories (replacing some of the original A's and C's) designate those changes which were most strongly implicated with improved performance: G = group games; S = small groups; T = tutoring; and D = Display of work. Table 1 lists these changes in more detail.

Insert Figure 2 and Table 1 about here

When a teacher's change was followed by an improvement in student performance, this suggested the change might be partially responsible for the improvement. For example, the teacher's graphs suggest that meeting with students in small groups may have facilitated mastery of some skills. On February 17, only two students had mastered the skill of telling time by the half hour and writing it in digital form. After small group meetings, eleven more students showed mastery. On March 3, only two more students since February 26 had mastered addition facts to eleven and twelve. After meetings with small groups on March 4, six more students showed mastery on March 5. Within the time frame of this project, although not all children achieved mastery in all the math skills, all of the students made progress in all the skill areas that they participated in.

EXAMPLE 2

In this project by the third author, sixteen children in a first grade homogeneous classroom of low achievers, 6 to 8 years of age, worked on addition facts. The materials used in the activities included pencils, timed tests, clock, math games, math books, chalk, chalk board, and flash cards. At the start of math class, the children did drill work on their math facts at the chalk board. This was followed by math relay games. The students would receive math instruction and practice in the math texts. As they completed their assigned work, the children were free to go to a math center where they could play math games either alone, in pairs, or in small groups.

Each week, a new group of facts was presented and tested, e.g. 1st week the "2's," 2nd week the "3's," third week the "4's." Children had one minute for 30 problems. Children recorded their own progress on individual charts. Each week's chart was placed on top of the previous week's chart so that the cumulative weekly records of individual children's progress were available for inspection.

After a few weeks, the records showed a problem with this procedure. As the arithmetic facts became more difficult, the children's scores, as a whole, showed little improvement, either from week to week or within each week. A failure to show improvement from week to week was understandable since the problems were becoming more difficult. However, the children also showed little improvement within each week while they were working on problems at the same level of difficulty. These results were not encouraging for the teacher or the children.

After the 5th week, a conference was held to discuss this situation, and the children subsequently did their problems under different instructional conditions. Instead of being tested on just the new group of facts, the children now were tested on the previous facts in addition to the new facts. This meant the children had the opportunity to improve their performance on all the arithmetic facts that had been presented to them so far. They also had four minutes to do 77 problems instead of one minute to do 30 problems. It was now much easier for them to show improvement from week to week. In addition, the children were given "stars" for each improved score. Other response consequences were connected to these improvements. For example, when all the children had two stars, they were given the privilege of eating lunch with the teacher in the "outdoor classroom" when the weather permitted.

Insert Figure 3 about here

These modifications resulted in a dramatic change in the children's performances as shown in Figure 3. Since the children had more time to do more problems, the absolute jump in the median total of correct problem is not as important as the charge in the trends. The class as a whole now shows a much stronger trend of improvement, both from week to week and within each week. The children had been given more opportunity to improve and more conspicuous evidence for their improvements. In addition, they were now also under classroom-wide group contingencies: there was now further motivation for all students to help one another so that the class could "celebrate" their achievement with lunch outdoors. This privilege would be another conspicuous indication of the class's accomplishments as a whole.

DISCUSSION

Both of the above examples illustrate the typical contrast between the scientist seeking verbal theory and the practitioner seeking practical action. Where the scientist is seeking to isolate variables for the purpose of making universal causal statements, the practitioner is combining variables for effective action. For instance, the small group activities in the first example were combined with self-recording and other features of the children's classroom environment. Since variables were combined rather than isolated, we cannot interpret the causal efficacy of each separate variable. All we know is that the package of variables as a whole permitted substantial achievement by the students. A similar package of changes was made before the improvements in the second example.

Although the teacher only needs one instance of an improvement to justify retaining a particular intervention, additional instances at different times give further theoretical support to the effectiveness of that particular intervention. For example, the improvement that followed the small group instruction on February 18 in the first example justifies further use of small group instruction. When we find that small group instruction is followed by improved performance later on Mar. 3 and 4 as well as Feb. 18, we can be more secure in our interpretation, particularly if we can plausibly rule out other causal events, which we can often do from our personal knowledge.

If sufficient evidence accumulates over time with systematic variation of plausible contributing factors, we are then justified in making a scientific statement on exactly what it was that made a difference. Thus, practioner actions that are responsive to systematic feedback can be an important preliminary to confidant scientific statements.

Both examples involved social discourse. When discussions are ongoing as in the first example, we are less likely to see sharp changes as a result of discussions since the discussions are part of the continuing context. In the second example, where there was less opportunity for social discourse, we find a clearer illustration of the importance of discussion in helping to make effective changes. The improvements in the second example appeared after a single conference. This conference provided the teacher with considerations for adjusting her instruction and record keeping. These changes might also have resulted from a small group discussion. However, it would have been more difficult, at the data indicates, for the teacher to attend to these considerations without talking about them to someone else. Although a teacher can make some effective changes on the basis of personal knowledge without help from others, additional help comes from involving others in discussions about the records.

Involving teachers, parents, and administrators in discussions of the records gives them a better understanding of what is going on in the classroom and allows them to give verbal feedback and active support more easily. If peer, administrative, or community support is lacking, this suggests a need for changes in the records or the way in which they are explained. Discussions, for example, may question the value of a particular record and suggest a better alternative. Discussions may lead to selecting a record for a more important curriculum objective or the discussions may indicate a more meaningful way of recording student progress. In this way, the curriculum goals themselves are evaluated and selected by discussions of the records.

In addition, discussions of their records will naturally occur among students, and this should be encouraged when children are motivated to cooperate rather than compete with one another (cf. Van Houten, 1984). Cooperative relationships are an essential feature for effective discussions and effective records. When responses to records emphasize individual student progress rather than comparisons between students, students are motivated to help rather than compete with one another. This emphasis on individual progress and cooperation can be furthered by maintaining personal folders of individual records which students can volunteer to share, by fostering small group and peer tutoring relationships that provide opportunities for students to help one another, and by directing special attention to the progress of the class as a whole and celebrating classroom-wide achievements.

It is also desirable to extend the advantages of self-recording to other subjects. Conspicuous quantitative features in a curriculum area like math are not essential to good records. Quality and quantity are like two sides of the same coin. Any qualitative indicator, like a check list, has its quantitative aspect, the number of checks. Conversely any quantitative indicator, like a frequency count, has its qualititative side, what it is that is being counted. Quantitative indicators of progress in a conspicuously quantifiable area such as mathematics are easy to discover. In areas where there are many qualitative indicators and no obvious one to quantitify, it may take more deliberation to select an indicator for recording.

Many times the best indicators of progress in areas with many qualitative indicators will be in collections of the child's actual work. Collections of a child's writing, for example, provide good indications of the child's writing development. Within collections like these, particular aspects may be addressed, either higher level skills like story grammar development or lower level mechanics like handwriting, spelling, and punctuation. Progress in these particular skills may then be recorded on checklists that may be stapled inside the folder of the child's collection of writing. More fine-grained frequency counts may be used in areas where progress is slow. "Talking about it" with someone else can be a big help in making these decisions.

In sum, the above examples illustrate features of systematic feedback cycles by which teachers can frequently find out how well their students are doing and how they can help them to do better. This feedback system serves multiple functions. First, self-recording provides a means by which children can learn valuable curriculum skills through graphing itself (time spent in graphing is not time out from learning the curriculum, but time spent in learning specific curruculum skills). Second, self-recording provides a motivating means by which children can monitor their individual progress. Third, a system of individual and class records helps the teacher monitor the progress of the class as a whole. Fourth, the overall record system, which should include a log of teacher changes, helps the teacher keep track of effective instruction and make changes to improve that instruction. And Fifth, these records provide opportunities for discussion which are valuable in making effective changes.

At some point these practices become amenable to more traditional scientific investigation and determination. A thorough scientific investigation, however, would involve a program evaluation of many schools. We would want to look at teachers implementing action science throughout the elementary grades. We would want to look at different ways for doing this, at different schools that do this, and at different schools that do not do this. Teachers do not have to wait until that time, however, in order to act effectively.

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Table 1 Selected Changes in Instruction

Date	Group Games	Small Groups	Tutoring	Displayed
2/12	Follow the leader			
2/14	Same as 2/12			
2/18		Met with all children in small groups	Met individually with those needing help	
3/4		Met with small groups needing help	Same as 2/18	
3/5		Same as 3/4	Same as 2/18	
3/6	Beat the clock			Completed papers
3/10	Toss ball			
3/11			Peer tutoring with 3 students	
3/12				Colored shapes
3/17	Centimeter scavenger hunt			
3/19	Inch scavenger hunt			Measurements from scavenger hunt
3/20	Prediction Game			
3/21			Peer tutoring with everyone	
3/25	Around the world			
3/26			Met individually with everyone	
3/27			Same as 3/11	

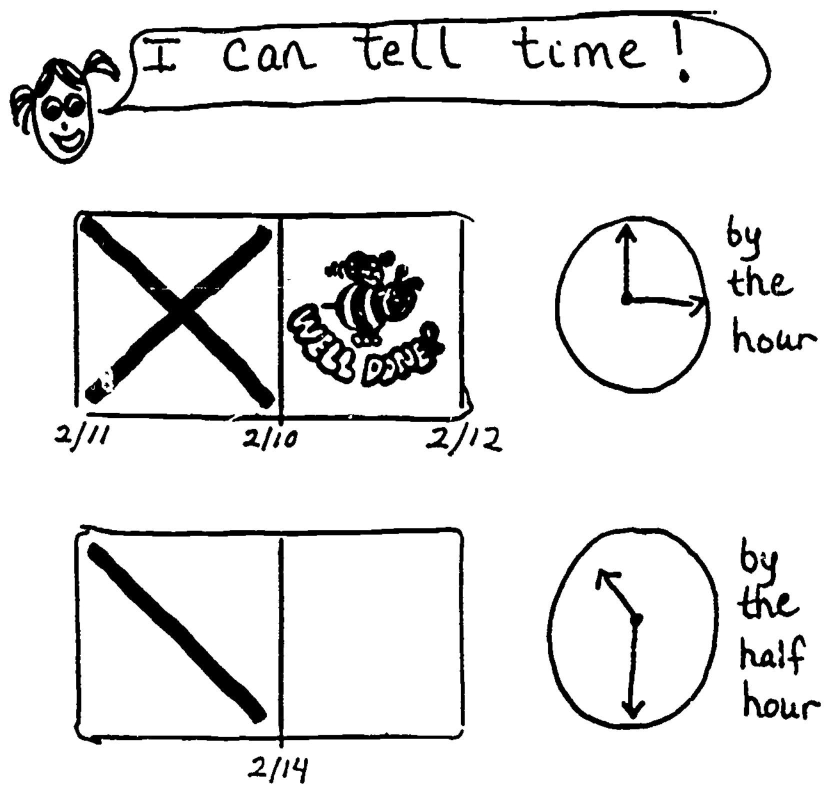

Figure 1. Example of How Progress is Graphed in the Individual Student Booklets.

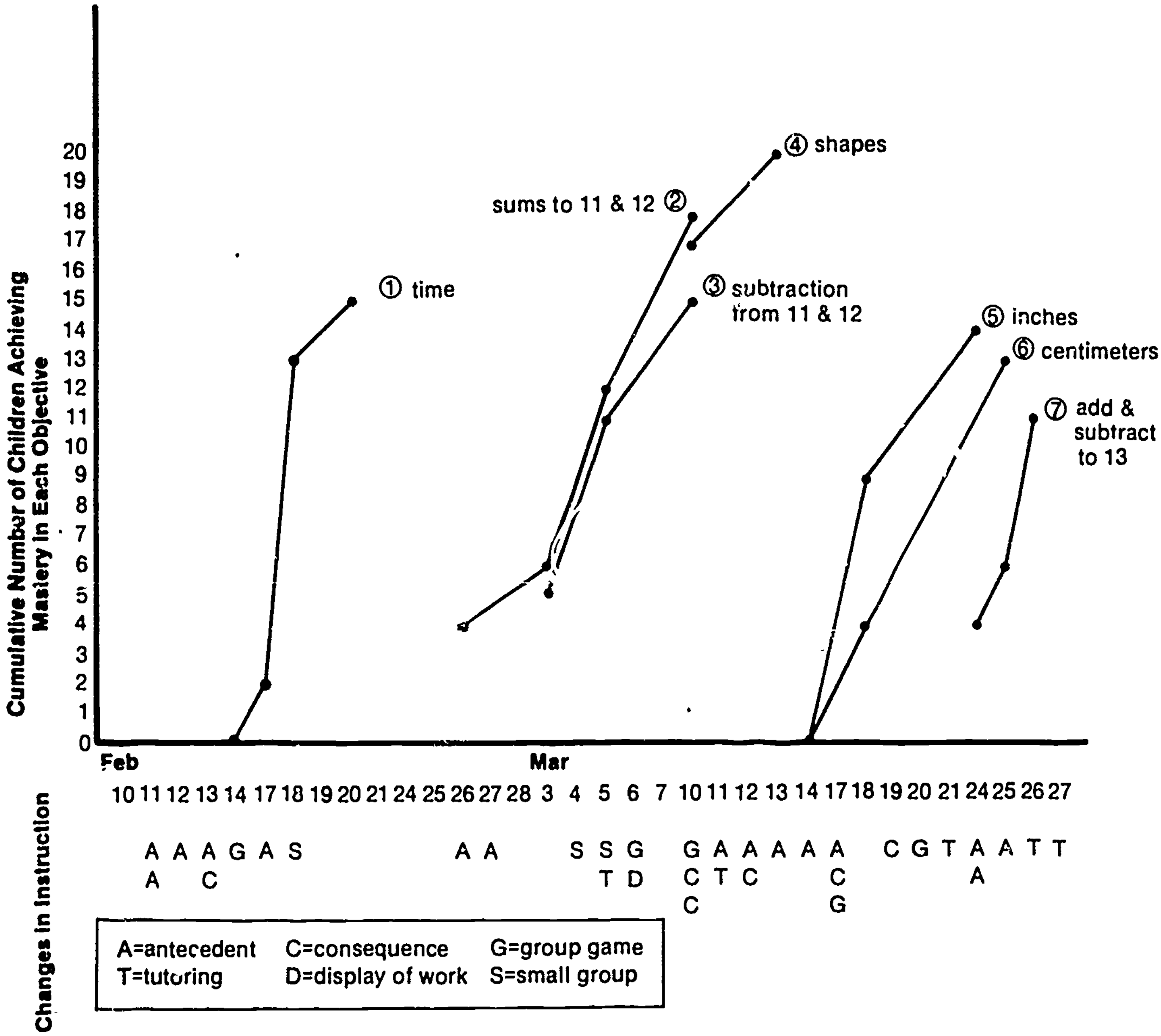

Figure 2. Number of Children Achieving Mastery and Changes in Instruction by the Teacher.

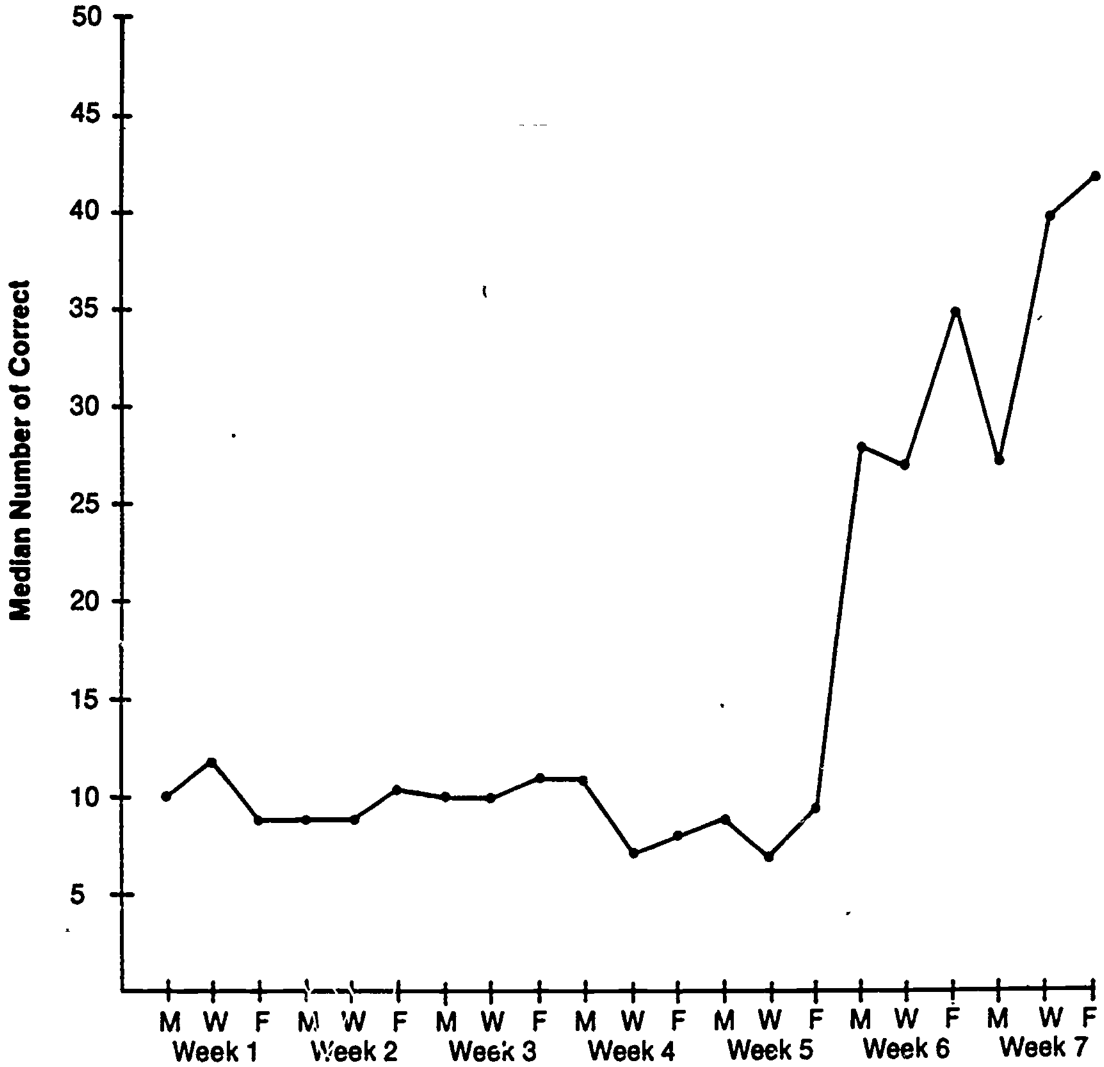

Figure 3. The Median Number of Correct Arithmetic Problems done by the 16 First Graders.