

**HOW THE USE OF ANSWER KEYS AFFECTS THE LEARNING OF
MATH FOR ACADEMICALLY WEAK STUDENTS**

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Dedication

I would like to thank, and in the process dedicate this paper to a number of people who have played a major role in my growth as an educator and as a person. First and most importantly, I would like to thank my wife Jeanette, who has put up with a lot over the last few years. To our two children, Gordon and Jamie, sorry for all the times I wasn't there. All of my professors in the department of education at the University of Lethbridge, specifically, Dr. Winzer who taught me so much about so much, to Dr. Mazurek, thanks for reawakening my love of human geography, Dr. Loewen who supervised this project, and Dr. Townsend who acted as my committee member.

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Abstract

The purpose of this study is to investigate the effect of two types of answer keys on the learning of grade 8 math students. This was a year long research project involving a group of 5 grade 8 math students each of which had a previous history of being academically weak in the area of mathematics, as defined by one or more final marks in mathematics of less than 60% (at the elementary school level). These students completed the regular grade 8 math course, using the B.C. curriculum, and their homework was delivered in three different styles; without an answer key, with an answer key consisting of only the correct answers, and an answer key consisting of all of the steps (work) written out for each question. The students were interviewed three times during the school year, and their attitude toward the three types of answer keys was explored.

The results of this study strongly suggest that an answer key consisting of all of the steps for each question together with the answer made a positive impact on the self-confidence and achievement of the students involved in the study.

Table of Contents

Signature Page	
Dedication	iii
Abstract	iv
Table of Contents	v
Introduction	1
Background Research	4
Purpose of Homework	4
Student Methods of Getting Help	6
Role of Worked-out Examples in the Teaching and Learning Of Mathematics	8
Special-Needs students and Learning Disabled Students in Math Classrooms	11
Study Questions	12
Methodology	12
In Class Preparation	13
Unit Divisions and Answer Keys	13
The Interviews	15
Course Evaluation	15
Students	16
Discussion	17
Interview Question #1	18

Interview Question #2	21
Interview Question #3a	23
Interview Question #3b	25
Interview Question #4	26
Interview Question #5	30
Interview Question #6	33
Interview Question #7	34
General Discussion	35
Conclusions	36
Summary	39
References	42
Appendices	
Appendix A: List of Interview questions	44
Appendix B: Interview Series Number One	46
Appendix C: Interview Series Number Two	62
Appendix D: Interview Series Number Three	82

How the use of Answer Keys Affect the Learning of Math for Academically Weak Students

Academically weak students often seem to have difficulty being successful in mathematics. There are many contributing factors to this situation. Among them are the speed of instruction, the volume of content being covered, the difficulties encountered when trying to complete homework, the effectiveness of homework as a learning tool, and the lack of background skills (both subject-specific and general learning strategies) that the individual student brings to the unit of study. This study looked at one way to improve the value of homework as a learning tool for a small group of grade eight students with general academic weaknesses.

This study looked at the use of answer keys as an aid to the correct completion of homework, in an effort to improve its effectiveness as a learning tool by academically weak students. Specifically, I wanted to find some way to have my students make sure that they were doing their homework correctly, so that they wouldn't internalize incorrect processes or methodologies as they practiced using new mathematical concepts presented in class.

I hoped to find out if answer keys, and specifically keys that include the steps used to reach the answer as well as the answer itself (worked-out answer keys), would help my academically weak math students as they studied mathematics. Additionally, I wanted to find out whether or not these students felt that an answer key consisting of the completed 'work' as well as the answers was any more effective as a learning tool than a key consisting of answers only. Finally, I wanted to find out whether or not student access to

an answer key added to the value of homework. Would providing a worked-out answer key provide useful support for my students at all of the stages in the learning cycle; skill development, guided practice, and independent practice?

To do this, I created two different types of answer keys (figure 1); answer-only answer keys and detailed answer key consisting of the entire solution, and all of the steps used in getting the answer (the ‘worked-out answer key’).

Page 7. #4a) 1, b) 8, c) -9, d) -13	Page 7. 4a) $3 - (+4) + 7 + (-5)$ $= 3 - 4 + 7 - 5$ $= -1 + 7 - 5$ $= +6 - 5$ $= +1$
“Answer-only” answer key	“worked-out” answer key

Figure 1: examples of supplied answer keys

These two types of answer keys were used by the students in separate units of study, interspersed with units of study presented without access to any kind of answer key (the traditional methods of instruction at the grade 8 level in this secondary school).

Prior to this study, grade eight math students at the school could only access an answer key by looking at the ‘Teacher’s Edition’ of the grade 8 math textbook. The text in use (Math Is 2, Ebos, F., Robinson, B., and Tuck, B. Nelson, 1984) doesn't include any form of answer key in the student edition. The lack of an answer key makes it difficult for students to find their mistakes and correct them, and it makes it difficult for a parent trying to help his/her child with a homework problem. By providing a fully detailed answer key I hoped to improve the learning of my grade eight math students, and get

them in the habit of checking their work.

Answer keys, especially ones that include the steps used to arrive at the answer, could potentially improve the learning of math, as it would provide students with a model solution that they could access in order to learn how to solve questions that they might not otherwise have been able to complete.

In a more general mode, the movement of course structure in British Columbia away from a teacher centered series of lessons to more independent student centered work, could increase the usefulness of answer keys that can be accessed by individual students on an as needed basis. Fully explained answer keys could help them learn individually and with their peers in small group settings. Answer keys could also have a role in peer teaching, as they could help in the visualization of the material for both the learner and the student who is in the 'teacher' mode.

There is a risk that some students might just copy the entire question out of the key thereby creating the image that they have done the work when in fact they have not. I felt that in the group with which I was working, a student who would copy answers from an answer only type key into their notebook would learn absolutely nothing from the exercise. However, if they were going to copy out all of the 'steps' involved in getting an answer (by copying out the 'worked out' style of key), they would at least have visualized, then written out, the steps involved in reaching the answer. In the process of copying out the steps the student may have internalized at least some of, if not all of, the steps involved in getting the 'answer'. In so doing the student would have accomplished at least some of the intended learning from the exercise.

In my experience as a teacher, I have found that academically weak students are less likely to use supplied learning tools. Consequently, I hoped to find out if my academically weak students in this study would actually use answer keys.

I also felt that it would be more ‘work’, or ‘effort’, for a student to use a worked out answer key, because s/he would be expected to use the work shown to diagnose his/her errors, instead of just finding out that s/he had a correct or incorrect answer. As a result, I wanted to find out whether or not these students would use the worked out answer keys, and whether or not they felt that a key with all of the work shown as well as the answer would be more useful than an answer key showing only the correct answer to the question.

The answers to these questions would lead to a change, and an improvement in the methods of supporting the learning of mathematics for academically weak students at the secondary school, and it would guide my future instructional decisions in my mathematics classes.

Background Research

Purpose of Homework

In class, students are exposed to new concepts and skills. They are guided in their development toward mastery with these skills through the use of guided practice in class, and then through independent practice at home, while doing homework. According to Faulkner and Blyth (1995), homework serves as a consistent way for students to gain practice time and experience with skills learnt at school (a consolidation and mastery of

skills recently presented to them). Homework is also a tool that allows the student to learn skills and to acquire information that is best learned at home. This article also states that there is "a small but solid body of research which suggests that regular homework which is both appropriate to the subject and correctly carried out can be a valid component of the learning process" (Earle, Keith and Cool, Tymmes and Fitz-Gibbons, and Murphy and Decker in Faulkner and Blyth, 1995 p. 448). A set of worked-out answer keys could support the student in the independent practice of the new skills being learned at home.

To both the student and the teacher "homework can stimulate the pupils' recall skills, enhance retention and generalization, consolidate what has been taught, assess performance and provide important feedback." (Mims et al., Earle, Hodapp and Hodapp, in Faulkner and Blyth, 1995, p. 448). As such, it may be assumed that homework has an important role to play in the instruction and learning of mathematical skills. If the ease and immediacy of feedback to students on their progress, methods, and mastery of the practiced skill(s) can be improved through the use of a descriptive answer key, which would provide the student with a tested explanation of the process, the effectiveness and appropriateness of the assigned homework may be improved for the individual student.

The National Council of Teachers of Mathematics (NCTM), in their Standard 12: Curriculum and Instructional Resources document comment that math curriculums should "include the major goals of developing students' problem-solving, reasoning, and communications skills" (Standard 12: Curriculum and Instructional Resources, NCTM, 1996, page 1). For a student who wants to learn how to do a specific math skill, access to

a worked out answer key could be a positive aid to the development of their problem-solving, reasoning, and communications skills, as this style of answer key would give them a logical starting point from which they should be able to think their way to the ‘why’ of the question (‘why, or how, did they get that answer?’). This type of key could be a logical starting point for peer discussion and problem-solving. The key could also be a source of confirmation or modification for the student, with respect to the strategies s/he used for solving a question, and for the reasoning s/he used in the process of arriving at their answer to the question. One outcome of this use of the worked-out answer key could be the empowerment of individual students in their growth toward independent learning (Standard 12: Curriculum and Instructional Resources, NCTM, 1996). Further, this type of an answer key would be a concrete tool that would help the individual student create knowledge through his/her experience.

Student Methods of Getting Help

According to Newman and Schwager (1995), students in grade six are likely to ask process-related questions, and to request process-related hints when they encounter difficulty in problem-solving. The researchers also comment that students of this age are quite likely to continue on in their efforts, however unsuccessful in them, rather than asking the teacher for help (Good, Slavings, Harel, and Emerson 1987 in Newman and Schwager, 1995). The provision of a diagnostic answer key would provide these students (and by extension, grade eight students, who are two years older) with a potential source of process-oriented help, without forcing the student to ask the teacher for help. As a

result, student access to an answer key that was self-diagnostic in nature could help to prevent individual students from internalizing incorrect methods of arithmetic and mathematics as a result of replicating the same error (or type of error) during drill and practice exercises. If the students reflect on the information provided in the answer key, then a worked-out answer key would then provide such process-related information as: explanations and clarification (hints), process rules ("do I add here?"), as well as a confirmation of the correct answer, or a request for the correct answer. It would provide a level of explanation for the student during the independent practice step of skill development.

A descriptive answer key might allow students who are unclear of the answer or the process, or who don't have confidence in their work the opportunity to clarify these concerns without the fear of negative teacher or peer responses. It could be a tool for self-debugging and self-correcting (Newman and Schwager, 1995). It would allow students to ask for feedback on performance, debugging, and so on in a setting with minimal risk of social embarrassment or harassment by their peers.

By using an answer key, and not depending on the attention of a teacher, a key consisting of the worked-out steps as well as the correct answer might help students achieve mastery and autonomy in the area of mathematics. Additional value might be realized in the area of cooperative learning, where a group of students could use this key without teacher guidance or prompting.

Role of Worked out Examples in the Teaching and Learning of Mathematics

Mayer, Sims, and Tajika (1996) completed a small study of textbook structure, comparing three Japanese and four American seventh grade math textbooks. Although small in scope, their findings were consistent in each text, and their comments on the American texts seem to be easily applicable to the grade eight Math is/2 text. The basis of their comparison was to try to explain the differences in testing outcomes between the two countries based on the style of textbooks used, and how the text related to how math is taught in the two countries. Their findings were quite clear - the Japanese texts spend a lot more time and space giving worked out examples - attempting to illustrate and explain the procedures involved in getting the answer and learning the skill being practiced. This finding supports their theory that the Japanese do better on international tests (than American students) as a result of their increased emphasis on the teaching of conceptual understanding and problem solving skills instead of on large numbers of questions and topics being taught.

In the Japanese texts, the students were provided with some worked out answers, while still having to complete work without worked out answers to guide them. In my study, the students were provided with a worked out answer for every question in the applicable units of study. The students were supplied with questions to do without answers to guide them through the use of assignments that were textbook independent (worksheets created from various other textbooks). This allowed the students to demonstrate their knowledge while having independent practice with the new skill.

Further comment in the Mayer article relates to research on instructional methods

that seems to show that problem-solving skills are better learned through the use of meaningful explanation (worked out examples) than through "unguided hands-on symbol manipulating" (Mayer, 1987, in Mayer 1996, p. 447). Mayer also comments that "research on multiple representations, case-based reasoning, and logical reasoning has demonstrated the important role of worked out examples and concrete analogies in helping students to improve their problem-solving skills." (Mayer, 1987, in Mayer 1996, p. 447). Mayer also comments that "Worked out examples serve to model appropriate problem-solving processes, and concrete analogies provide a means for connecting procedures to familiar experiences." (Mayer, 1996, p. 447). He also states that the use of consistent, relevant illustrations aids instruction (Mayer, 1996, p. 448), that solved/worked out answers and examples teach process understanding and cognition (Mayer, 1996, p. 448), and successful teaching of problem-solving processes rely on the use of cognitive modeling techniques - such as detailed descriptions of worked out examples (Mayer, 1996, p. 449).

Jitendra and Kameenui (1996) comment that novices (in math) needed more prompts than did experts in the solving of mathematical questions. A worked out example showing the 'next step' could be a useful aid or prompt to the solving of a given question for a novice (or weak) math student. Further, the availability of worked-out answers for word problems would aid the students' comprehension of that problem, which would increase their likelihood of learning the processes involved (Jitendra and Kameenui, 1996, p. 48). Jitendra and Xin (1997) comment that the availability of worked out solutions is a useful aid to the success of learning disabled students, as the solution

can aid the student in choosing the correct operation, plan their operations, and checking their work/answers. Such an answer key could provide modeling, guided practice, and it could lead to improved performance for the student (Jitendra and Xin, 1997, p. 429).

According to Pehkonen (1992, abstract), many students "have a pragmatic, calculation-centered, task-oriented view of mathematics; they emphasize process more than product; they stress rigorous working procedures and learning through practice; and they favour pupil-centered activities and small group learning", a descriptive answer key could be a very useful tool for them to use in learning processes and appropriate procedures to use to solve a given question.

There may also be a connection to the process of initiation of the student into the conventional, social ways of doing mathematics through the improved access to properly modeled work for the individual student. "The initiation of the student into the socially conventional ways of presenting mathematics can be more effectively grounded in his or her personal experience." (Brown, 1996, abstract). The provision of a worked out answer key could provide that personal experience for the student through the student's private use of the key or through small group peer discussion of the processes illustrated in the answer key. The availability of a descriptive answer key could also allow a teacher to be more sensitive and responsive to the mathematical thinking of the (individual) student (Simon, 1995, abstract) The answer key would provide information to the student that would allow them to focus their question to the teacher on a specific step or process shown in the worked out question. By having a more focused question to begin from, the

teacher could more easily probe the student for the information needed to better teach or explain the needed skill to the student.

A student using a detailed answer key would be able to compare his/her work to the example in the key. In this way, the student could narrow down the source of his/her error(s), then make better choices on which type of error she/he has made (methodological or arithmetic), and as a result of this decision make the appropriate (and correct) changes to his/her work. A result of this process would be the development of a better understanding of the various processes involved in the calculations and problem-solving processes that they are learning/practicing.

Special-Needs Students and Learning Disabled Students in Math Classrooms

Hollander (1988) states that mathematics textbooks are difficult for learning disabled students to read. This difficulty is based on content, text structure, page format, vocabulary, and on visual symbols used. A descriptive answer key may be an effective aid for these students, as it would give them an additional, independent, aid to use when trying to decode a question, or to decide on a process to use to solve a given problem from a homework assignment. It would also allow students to check their answer, and to work backward from the answer to the question in order for them to find the source of their difficulty.

Newman and Schwager (1995) comment that severely learning disabled students tended to ask for process-related hints when they encountered problems during the solving of mathematical questions - a descriptive answer key could be an additional

source for them to use to get the desired hint, without the need for interaction with a teacher, peer, or parent, all of which are potential sources of incorrect information for the individual.

Study Questions

The following questions will be answered over the course of the study.

1. Do academically weak students have more confidence about the growth in their math skills when using answer keys than when not using answer keys?
2. Are answer keys that include the worked-out question a more effective learning tool than answer-only answer keys for academically weak students?
3. Do academically weak students actually use answer keys on a regular basis when they have access to them?
4. Do academically weak students model their work after the style shown in worked out answer keys?
5. Do academically weak students feel that they learn more (or better) when they have access to answer keys, both worked-out, and answer-only types, than when they don't have access to them?

Methodology

This study was completed over the period of one school year, September 1997 – June 1998. During this period of time, I taught math to a group of six grade 8 academically weak students.

In-Class Preparation

In preparation for the use of answer keys to self-correct homework, I introduced the study, and I explained to the class as a whole that the value of an answer key was to let you check your work as you did it, so that you could correct your work in progress, instead of ‘the next day’. In response to student questions about ‘why’ they should use the answer keys, I explained that the use of the keys could lead to four important new outcomes from their homework; 1 - you would not learn, or internalize, incorrect processes that would result in process type errors, 2 - you would catch more arithmetic errors, 3 - you would be in a position to ask questions in class that were appropriate to solving a specific process or skill development problem that you had encountered in your homework, and 4 - by correcting your mistakes while you did the work, you would get a higher homework mark in class the next day. During the course I reminded the students that they had access to answer keys (during appropriate units) and that the keys were there to help them learn, and do, their homework. What I attempted to do with the group was to give them some reason to apply the extra effort of using the answer keys while doing their homework, and that using an answer key was not cheating on your work.

Unit Divisions and Answer Keys

The course was divided into nine sections, or topics, and was taught using teacher-centered lessons, where the teacher began each lesson with a review of the previous day’s homework (fielding questions, recording marks, reviewing skills) followed by either further practice activities, or the introduction of a new skill or skills to the class.

The final portion of the class consisted of practice questions being assigned to the students by the teacher. During this period of time, the teacher moved among the students giving individualized instruction as needed, or requested by the students. This in-class practice material was completed at home, as ‘homework’ by the students on a daily basis. For each of the nine units of study, one of the two different styles of answer keys, or no answer key at all, was supplied to the student.

At the conclusion of each group of three answer key styles, the students were interviewed as to their attitudes toward the use and value of each type of answer key. The order of use of each style of key was be rotated so that the interviews took place immediately after the delivery of each style of answer key.

The style of unit delivery and homework answer key used was as follows;

unit 1: Order of Operations, Rounding	-no answer key
unit 2: Factors and Multiples, Powers	-answers-only answer key
unit 3: Fractions	-worked-out answer key
interview session 1 (appendix B)	
unit 4: Measurement (Perimeter)	-answers-only answer key
unit 5: Measurement (Area and Volume)	-worked-out answer key
unit 6: Integers (Comparing)	-no answer key
interview session 2 (appendix C)	
unit 7: Integers (Adding and Subtracting)	-worked-out answer key
unit 8: Integers (Multiplying and Dividing)	-no answer key
unit 9: Algebra	-answers-only answer key

interview session 3 (appendix D)

exam review

end of course

The Interviews

Each interview took place on a one-to-one basis with the student, either after school or during class time, in a room separate from the rest of the class. Each student was asked the same questions in each session, with additional questions asked as required to draw out valid information regarding the students' attitudes toward and use of the various units of work and the two types of answer keys that they had experienced. The interview questions are given in Appendix A, and the transcripts of each interview session are in Appendix B (interview session one), Appendix C (interview session two), and Appendix D (interview session three).

The three interview sections occurred in mid-January, early May, and early June. The varied timing of the interview sessions was a result of the time required to work through the various units in the course. The interview transcripts were transcribed on an ongoing basis throughout the study period as time permitted.

Course Evaluation

The course was taught in a traditional manner, meaning lesson development was primarily teacher centered, followed by seat work and homework. Evaluation took the form of marking homework (student controlled), assignments, quizzes, unit tests, and

two formal exams, one in January, one in June. All of the grade eight students in the school received the same tests and exams.

Students

The students participated in the study with the written permission of their parents. Letters of permission were signed and kept on file. Additional comments by the students were noted in a teacher-generated journal, which was used for casual comments and observations throughout the year. All of the students who were in this course, whether they participated in this study or not have had their names changed in order to maintain their privacy. Their names are consistent throughout the study. Five of the six students in the class participated in this study.

The assigned names given to the students in this study are Jane, who did not participate and Sue, Daphne, Dan, Jake, and Louise, all of whom did participate in the study.

Of the students who took part in the study, three of the participants were female, and two were male. All were of appropriate age for their grade. Attendance was good for all students, with Louise having the highest absentee rate over the course of the school year. The grade seven math marks for these students were all marginal, the highest grade assigned was a 'C' (no percentage equivalent, defined as 'average'), which Jake achieved. Sue and Daphne were given a 'D' (below average), while Louise and Dan had 'F' on their final grade seven report card ('unacceptable'). All of these students had at some point in elementary school received formal learning assistance in the subject area

of math. Over the period of grade eight, none of these students received any learning assistance support.

Discussion

The following chart lists the seven main questions that were used in each interview session and breaks the student responses into appropriate groupings. Each interview consisted of seven main questions, with follow-up and probe questions where needed. These questions were structured draw out the attitudes and feelings of the students on the use of answer keys, and to clarify answers and follow-up on ideas and comments made by the students that might have added to the information derived from the study. Based on the responses to the probe questions that were asked in the first interview session, two more questions were used in the second and third interview series.

Table 1: Interview Question Responses

Question Number	Interview #1	Interview #2	Interview #3	Total
1. In which unit of study did you find the homework easiest to do?	no answer key: 0 answer-only key: 2 worked-out key: 3	no answer key: 1 answer-only key: 1 worked-out key: 3	no answer key: 1 answer-only key: 0 worked-out key: 4	no answer key: 2 answer-only key: 3 worked-out key: 10
2. In which of the three previous units of study did you find the homework most useful in helping you learn the material presented?	no answer key: 1 answer-only key: 1 worked-out key: 2 unclear: 1	no answer key: 1 answer-only key: 1 worked-out key: 3 unclear: 0	no answer key: 0 answer-only key: 2 worked-out key: 3 unclear: 0	no answer key: 2 answer-only key: 4 worked-out key: 8 unclear: 1
3a. Did you use the supplied answer keys when you did your homework?	yes: 4 no: 1 sometimes: 0	yes: 3 no: 1 sometimes: 1	yes: 5 no: 0 sometimes: 0	yes: 12 no: 2 sometimes: 1
3b. How did you use the answer key?	while you did your homework: 1 after you were finished your homework: 3	while you did your homework: 1 after you were finished your homework: 3	while you did your homework: 2 after you were finished your homework: 3	while you did your homework: 4 after you were finished your homework: 9
4. Did using an answer key affect your learning from the homework?	yes: 2 no: 2 sometimes: 1	yes: 3 no: 1 sometimes: 1	yes: 3 no: 1 sometimes: 1	yes: 8 no: 4 sometimes: 3
5. Of the two types of answer keys, which type did you find the most useful?	answer-only: 1 worked-out: 4	answer-only: 1 worked-out: 4	answer-only: 1 worked-out: 3 unsure: 1	answer-only: 3 worked-out: 11 unsure: 1
6. Has the use of answer keys changed the way you do math?	not asked	yes: 4 no: 1	yes: 2 no: 3	yes: 6 no: 4
7. Did you use the worked-out examples to guide how you did your homework?	not asked	yes: 4 no: 0 undecided: 1	yes: 4 no: 1 undecided: 0	yes: 8 no: 1 undecided: 1

Interview Question #1

The break down of the responses to the question “In which unit of study did you find the homework easiest to do?” was very consistent throughout the study. Ten of the fifteen responses over the three interview sessions choose the unit of study that corresponded

with the worked-out answer key supplied while three of the remaining five responses choose the answers-only style of answer key. The pattern of student responses to this question were consistent throughout the study, with a slight increase in 'worked-out' key responses in the last interview session. I feel that these responses support an answer of 'yes' to the first research question "Do academically weak students feel better about their math learning when using answer keys than when not using answer keys." The first set of interviews happened at the end of the first three units of study, and the students had just finished using the worked-out answer keys. In this series of interviews, three students found the unit associated with the worked-out style to be the easiest while two felt that the unit with the answers-only style of key to be the easiest. In their responses, those three students stated that the reason for their choice revolved around the keys showing them how to do the work, and that they had something to which they could compare their work. The reasons given by the two students who preferred the answers-only style of key revolved around the topic of study - Daphne felt she knew rounding "...the best how to do it.", and Jake's responses imply that having the answer to refer to was all he needed to check his work over and find his mistakes. In the second round of interviews which happened after the unit with no answer key provided again three of the students chose the unit that had the worked-out answer keys, one student (Sue) found the unit with the answers-only key to be the easiest, because, as she said, "like there was only a couple of steps in it." (It was the unit on perimeter), and one student (Dan) felt that the unit without an answer key was the easiest one. His reason for his choice was somewhat unclear, in that he stated "Well, I just kinda like showing my work and then, like, doing it myself

kinda thing.”, then shortly afterward he said that having an answer key helped him out in that unit - even after I reminded him that he didn't have access to an answer key for that unit. In the last series of three units, (interviews occurred after they had a unit without an answer key) four students chose the unit that had the worked-out answer keys, and one student (Daphne) felt that the unit without an answer key was the easiest to do. When asked why she chose this unit, her answer was “I just find them easy to do”.

For all of the students who had chosen the unit with the worked-out answer keys as the easiest to do, there was a strong, common thread through all of their responses to the follow-up ‘why’ question; the worked-out answer key helped them to do their work. As Sue stated in her third interview; “Cause it showed you how to get the answer. And dealing with steps and stuff”.

Since having access to the supplied answer keys seemed to help these students enjoy a higher level of success, and student-centered problem-solving (with respect to learning how a question is done), this access should also allow these students to feel better about their math. Access to answer keys should also allow these students to work more independently on their math, again allowing them to feel better about their math work.

Over the period of the course, the students completed approximately the same number of homework assignments in all units. However, they did tend to get a higher mark, (a product of completion) in the units where they had access to some form of answer key, especially the worked-out style. With the worked-out answer keys the students could overcome more problems they encountered with process than in the units without models to follow.

The second research question, “Are answer keys that include the worked-out question a more effective learning tool than answer-only answer keys for academically weak students?” is also addressed in the responses to the first interview question. As ten out of fifteen responses choose the worked-out key, while only three of the fifteen responses choose the answer-only key, (67% to 20%) it seems that the students felt (as demonstrated by their choice) that the worked-out keys were a more effective learning tool for them.

The question “Do academically weak math students model their work after the style shown in the worked-out answer keys?” is addressed through my observations of the students’ work throughout the period of the study. The students continually modeled their work after the examples to which they had access. I believe that the availability of examples from which they could model their own work was a factor in their choice of which unit had the easiest homework to complete.

Interview Question #2

The second interview question; ‘In which of the three previous units of study did you find the homework the most useful in helping you learn the material presented?’, 12 of the 15 responses choose homework with some form of answer key. Of these, eight responses picked the unit with worked-out answer keys, and four picked the answers-only units. Their reasons for their choices was very consistent throughout the study - having an answer key helped them deal with problems, and the keys modeled the correct procedure to use in working toward the correct answer. There was one student in each interview

session who selected the 'no answer key' response: Daphne in the first round of interviews picked the unit without an answer key because she "knew how to do it", and Louise in the second unit, stated that the unit without an answer key was "just easier." One student response was unintelligible.

The student responses to this question support an answer of 'yes' to research question 'Do academically weak math students feel better about their math learning when using answer keys than when not using answer keys?' If they feel good about their learning, as demonstrated by their belief that the keys helped them learn the material, then they are likely to feel good about their learning, and their progress in math.

The students seemed to feel that the worked-out answer keys are a more effective learning tool than the answer-only style of key (research question #2). This is demonstrated by their responses to this question (80% of the responses said that they found the worked-out keys most useful in helping them learn the material).

I would suggest that the responses to this question also support an answer of yes to the third research question, in that students would need to use the answer keys on a regular basis in order to find them useful in learning the material.

A positive response to the fifth research question (Do academically weak math students feel that they learn more (or better) when they have access to answer keys, both worked out, and answer-only types, than when they don't have access to them) is supported by the student interview answers to the second question quite strongly. To perceive the use of a worked-out answer key as a learning tool, you are quite likely to use it to model your style and form after it.

Interview Question #3a

The students quickly adapted to the existence of an answer key (either type), as shown by the responses to the question “Did you use the supplied answer keys when you did your homework?”, where 14 of 14 responses were positive (including Daphne’s and Sue’s ‘sometimes’ answers). This response pattern shows that every student used the supplied answer keys at some point, and most used them on a regular basis, over the course of the school year.

The two ‘sometimes’ responses occurred in the second interview session, and they may have reflected a loss of answer keys by the students (both Daphne and Sue did lose their keys during this interview cycle - Daphne lost hers at least once a unit), or may have reflected a lack of effort on their part (Daphne has stated in one interview response that checking her work was too much trouble). The “sometimes” responses may also have been a product of the fact that particular units of study appeared easy to do, and so checking work (or doing homework) was not deemed necessary by the individual students. The idea that checking your work is too much trouble was quite common in this study, as Daphne reflected this attitude throughout the course, and she was also one of the two students most likely to arrive in class without their homework done. From this observation, I tend to think that simply supplying an answer key does not in itself make the work easier to do, as the student must still have the inclination to actually do the work. Additionally, both Daphne and Sue still felt that having the answer key helped them do math, even though having a key did not seem to improve their rate of doing their homework (although it increased the likelihood that the homework they did do was going

to be correct).

Louise responded to the question ‘Did you use the supplied answer keys when you did your homework?’ by saying “...I...did not (unintelligible) I just checked back sometimes if I didn’t (unintelligible) if it was really wrong or something.” This response suggests that although she did access her answer key, she didn’t do it very often. Further, her explanation as to how she knew her work was incorrect; “Well, just the way the work was done out and like sometimes I calculate it and calculate it and I’d come up with the wrong answer so I knew my work was wrong...that I had the wrong answer” doesn’t explain how she figured out her work was wrong in the first place - did she use estimation skills, did she compare her work with others, or did she check the answer key? Further questioning got her to say that she knew her answer was wrong because she was looking at the answer key. I feel that her series of responses suggests a poor learning technique on the part of this student. It also suggests that this student learned better when she had access to an answer key (research question #4).

The responses to this question support a ‘yes’ answer to the first research question, as the students in the study seemed to integrate the answer keys into their tool bag of resources to use while doing, and learning, math. Answer keys are a tool that can increase the independence of individual students with respect to their ability to do math, and to feel good about it. This question also answers the third research question positively as well - the students consistently stated that they used the supplied answer keys to help them do math.

Interview Question #3b

The overall responses to this question (four responses stated that the keys were used while the student was doing their homework, and nine responses stated that the student waited until after they completed their homework) suggest that the students need to be taught, and given practice with, the use of answer keys as a learning tool.

A common type of comment from the students revolved around the idea of cheating, in that they felt that if they accessed the key while they were still doing their homework, they would be cheating. This concept had to be continually addressed, and the students had to be shown that by looking at the key as they progressed through the work they would be more likely to avoid internalizing an incorrect methodology that would have to be ‘unlearned’ later. Ongoing use of an answer key would also mean that the student would not spend as much time doing work incorrectly, and as a result, would spend less time redoing their work. This change in their behaviour would then lead them to a more efficient use of their time. The third research question is addressed by this interview question, in that it has told me how the students have used their answer keys when they have access to them (after they completed their homework).

This question also suggests that some students do model their work after the answer keys, but not all students do, nor do students do it all of the time. The second research question is addressed here as well, as it demonstrates that not all of the students use the worked-out answer keys as effectively as they could be.

Interview Question #4

The fourth question, ‘Did using an answer key affect your learning from the homework?’, was possibly the most important question in the interview sessions. It addressed, directly and indirectly, all of the questions posed in this research project. I used this question to get some idea about potential changes in the learning behaviours of my students. Given that eight of 15 answers were positive, three were undecided, and four were negative, I feel that the introduction of answer keys, especially the ones with the questions completely worked out, lead to a positive change in the learning behaviours of the students - they became more independent in their problem-solving skills, and their general learning styles.

The following benefits were stated or noted by the students; a general shift to a more independent learning style, a positive change in the level of independent problem-solving skills, improved effectiveness of homework as a learning tool, increased student confidence on specific exercises, a decrease in the amount of frustration while doing homework, a student-centered method of reducing mistakes, an increased likelihood of completing a given homework assignment, an increase in the learning by individual students from their homework, and a worked-out homework key was an effective model from which students could learn.

A comment made by Jake in the second interview, (“I could look up my mistake, what I did wrong, and change it and then in the future I didn’t make that mistake again”) suggests a student shift toward a more independent learning style, where s/he is self-checking, and learning what s/he needs to learn, as s/he needs to learn it.

Daphne, in her first interview commented that “Because when your done you can check it over and then when you go to school you can know what steps you do and stuff.” This comment implies that the use of an answer key improved the effectiveness of homework as a learning tool. She also commented (in her second interview) that when she had use of the answer-only style of key, she could “work out the problems yourself and keep on figuring out where your mistake was”. This comment suggests that she used these keys to move toward a more independent style of learning and problem-solving, despite her inconsistent use of the answer keys. Jake, in his second interview, supported this feeling, both in his general comments about finding his “stupid” mistakes, and also in his response to my question on why he felt the worked-out answer keys were more effective: “Cause, I could understand it faster, and a lot easier.”

Evidence of a change in student confidence on specific exercises, and a concurrent, positive change in their level of independent problem-solving skills can be found in the first interview. Louise commented that she did more of her homework when she had an answer key because she could “understand how to do it.” Daphne, (who in the second interview stated that the answer keys didn’t affect her learning), later on in the interview agreed that she modeled her work after the completed examples, and that made her feel more confident doing that particular exercise. Sue, (although she said that the keys did not affect her learning) later on commented that the keys helped her by showing “...what specific thing you’re supposed to do for each step.” The support that she received from the existence of a worked-out answer key increased her feeling of confidence when attempting to practice a new skill.

Daphne, (in her first interview), suggested that access to an answer key made her homework less frustrating. “Cause then you work it out by yourself and keep on working until you know how to do it and get the right answer.” In the second interview, Daphne specifically stated that answer keys made her homework less frustrating when she responded to the direct question “Did that [looking at the model to see how to set the work up] make your homework less frustrating?” stated that “yeah [it made the homework less frustrating].” This comment shows quite clearly that for her, access to an answer key led to a decrease in the amount of frustration she experienced while doing her homework.

Access to a worked-out answer key was an effective student centered method of reducing mistakes. Dan, during his second interview stated that having an answer key affected his learning, in that “...it prevented most mistakes. So that I guess that it might, helped quite a bit.”

In her third interview, Louise stated that with the completed answer key she could look back to the step where she made her error and fix it, which suggests that she may have learnt from the correction.

Dan, in his third interview, simply stated that he “learnt more” with an answer key, especially the keys with the questions worked out. Jake also suggested that he learnt more with a worked-out answer key when he said in his third interview that “..with the steps worked out it helped me, ah, figure out what I did wrong...and, ah, just helped me”.

Sue, in her second interview, when she responded to the question “were you more likely to finish your homework if you had an answer key” stated that “yeah”, she was

more likely to finish her homework because “If I didn’t have it, and I had some questions I would have just left it, and then asked you for help or something.” Instead, she was able to work through most of the problems she had with the homework without having to wait until the next class to ask the teacher a question about the homework. This comment strongly suggests that the existence of a worked-out answer key increased the likelihood of her completing a given homework assignment.

Access to worked-out answer keys led to increased learning for individual students. Louise stated in her third interview that “The other topic was easy, and the answer key helped me too...[because] ...the answers were worked out so it was easier for me to understand it.” She then described the biggest difference between the two styles of answer keys; “When its worked out [the answer keys] it sort of helped you ‘cause it sort of like, like tells you the steps and if you do a step wrong you can look back and see what step it was.” Josh, in his third interview, says that the homework helped him learn the most when he had access to a worked-out answer key because the key “...showed me how to do it”. Josh also commented that he knew what he was doing (when he was doing his homework) because he used the key to check his work “a couple of times and eventually I knew what I was doing.” He agreed (in the third interview) that the answer keys helped him to develop the confidence to know what he was doing.

Sue, (in her third interview), commented that an answer key “...made it easier...to follow ‘cause of all those steps were all worked out for you so all you had to do was follow them.” This comment shows that Sue was using the worked-out key to model her own work after, which can be an effective learning strategy to follow as a student moves

toward independence in their application of a given skill.

Daphne was the only 'no' response, in that she didn't feel that the keys affected her learning; because the use of an answer key was cheating. This concern was repeatedly addressed in class, where I, and the other students, reminded her that it was not cheating to look back on your work to compare the answer that she got with the answer provided. Daphne continued to feel that she was better off not using the answer keys, and getting lower homework marks than she would by accessing the answer keys to check her work. Daphne had a tendency to not complete homework, not study for tests and not finish assignments. I believe that Daphne's refusal to use the answer keys may have been more a product of her refusal to 'do the work' required of her to learn the material, and not really based on her feelings of 'cheating'. This comment may not have been indicative of Daphne's actual use of the homework keys, as she mentioned in response to another question that the answer key's made the homework less frustrating for her (see above). She also admitted (in her second interview) that she didn't use the keys on a regular basis because "...it takes too much time to check your work after."

Interview Question #5

On the question of which style of answer key was found to be most useful, the students were very strong in their feelings that the worked-out answer keys were the most useful style of answer key, choosing it 11 out of 15 times. Three chose the answers-only style, and Louise, in her third interview, was unsure of which style she liked best, although she did state that "When its all worked out it sort of helped you 'cause sort of

like, like tells you the steps and if you do a step wrong you can look back and see what step it was.”

The students strongly felt that the most useful form of answer key was the worked-out style. They gave their reasons for their feelings, and as demonstrated by the following examples, they clearly explained that they liked the worked-out style of key the best. This was because it showed them, or explained to them, the step that was causing their problem in reaching the correct answer.

During the first set of interviews, Louise stated that the worked-out answer keys helped her “understand everything”. Dan commented that “Well, I just...sometimes I was completely lost in the work. And I just...I spent a long time working on it and then I went back and checked the steps and tried to do my work that way from the answer key”. Mayer (1987), refers to the “role of meaningful explanation rather than the unguided hands-on symbol manipulating activities in promoting problem-solving competence” (p. 447). Jake illustrates this statement in his first interview when he said that he didn’t like the answers-only style as much [as the worked-out style] because “...it doesn’t really uh, it doesn’t explain it. It doesn’t explain how to do it”. This particular comment ties into the idea of having an answer key help the student learn independently of outside help. It supports the idea that by providing the steps for a student to model their work after, a worked-out answer key allows the student to gain the explanation they may need to learn the process being practiced in the homework. This feeling is reflected in Mayer (1987), when he says “worked-out examples serve to model appropriate problem-solving processes, and concrete analogies provide a means for connecting procedures to familiar

experiences.” (Page 447).

Sue’s response to the question in the first interview also supports this idea; “ ‘Cause it [worked-out answer keys] shows you how they got the answers.” During the second period of interviews, Jake commented that he liked the worked-out answer keys better because he could “understand it faster, and a lot easier.” He further added that with the steps in front of him he could “look up [his] mistake, what [he] did wrong, and change it and then in the future [he] didn’t make that mistake again”. Dan commented in the second interview that the worked-out answer keys had taught him to begin each question with the general formula, and how to set up his work to keep his notebook neater and more organized. Sue stated quite clearly in her second interview that the worked out keys “showed you how to do it...properly”. The responses in the third series of interviews were similar to the above examples - the worked-out keys explained the work, modeled the correct steps, modeled well organized work, and solved problems for the students.

In his third interview, Jake commented that he would have liked to have the worked-out style of answer key instead of the answers-only style during the algebra unit because “some that I got wrong I couldn’t fix it ‘cause I couldn’t find where I got it wrong”. Having the steps outlined for the student would have helped Jake reach a higher level of independence in his learning and problem solving if he had had access to a worked-out answer key.

Daphne was the one student who preferred the answers-only style of answer key, and she did in each interview session. Her reason in the first interview was that, after checking her answer, she could then continue to “work it out by yourself and keep on

working it until you know how to do it and get the right answer.” In the second interview she said that she didn’t use the worked-out answer keys on a regular basis because “it takes too much time to check your work after”, then she explained that she liked the answer-only style best because “ you can work out the problems yourself and keep on figuring out where your mistake was”. This was the same pattern that she exhibited in the third interview. She also, in her responses to other questions, referred to her fear or temptation, of cheating by just copying out the work. Having stated that, Daphne responded to a direct question in the second interview that the worked-out answer keys did make her homework less frustrating to do;

Interviewer: Did that make your homework less frustrating?

Daphne: Yeah.

She was also the student least likely to have completed her homework, regardless of the unit, or the style of answer key supplied.

Interview Question #6

The sixth interview question, ‘Has the use of answer keys changed the way you do math?’ was answered positively (yes) by four of the five students in the second interview (the first time the question was asked), and two out of the five students during the third round of interviews. To me, the clear indicator of change was the first time the question was asked, as I believe that the students, having already changed the way they do math the second time they were asked the question, would have answered ‘no’, since the change was no longer new to them. Jake commented, in response to the question, that

answer keys had changed the way he did math “a lot”. He further went on to explain that he would now go back over his work to check it, and to check it step-by-step. This resulted, he said, in his finding and fixing “stupid mistake[s], like putting a wrong number down...” In general, access to answer keys seemed to increase the amount of, or number of, steps that students wrote out. It changed the type of questions they asked in class into more process-oriented questions, instead of the traditional ‘what is the answer to question number...’ homework related questions that they used to ask. The keys also increased the confidence of the individual students when doing their homework - they were less frustrated by problems, and they were more effective in small group work activities when they had an answer key available to them.

Interview Question #7

The final interview question, ‘Did you use the worked-out examples to guide how you did your homework?’ which was added to the series of interview questions before the second set of interviews, resulted in eight ‘yes’ responses (eg, Jake’s response in the second interview “Oh yeah, lots of times, most of the time”), one ‘undecided’, and one ‘no’ response. Many of the previously stated quotes support this positive view, in that they give many examples where the worked-out keys were used to model work by the students.

General Discussion

The majority of the time, as demonstrated by nine out of 13 responses to the question “How did you use the answer key?” the students in this study chose to access their answer keys after they had completed their homework, even though I had taught them, and reminded them on a regular basis, to check their work as they progressed through it. The stated reason that I gave for my suggested approach was to prevent the learning of incorrect processes or techniques. This didn’t seem to have much impact on the homework checking behaviour of the students in this study. I feel that the reluctance of the students to adapt the desired use of either style answer key came from three sources, one being simply that the use of answer keys was new to this group of students, and they needed more time to completely adapt to the efficient use of the learning tool to which they had been introduced.

Secondly, the students had a fear of cheating, and they may have felt that if they checked their work as they progressed, they would end up just copying the work and the correct answers down. For example, Louise said during her second interview, “...some people could like just go and copy it down or something.” Jake directly referred to this fear in his third interview; “Just so I couldn’t peek at it and just put the answers down”. In her third interview, Daphne also commented on this attitude, specifically with respect to the worked out answer keys, when she commented;

“Because... You’re not really ... using anything, like, when you have the ones just the answers ... with the answer keys, ... you’re just, looking at the answers and not all the written ones out. But I think when you use the ones with all the writing on it I think you’re cheating in a way”.

The final reason, was that using an answer key while you are doing the work (and sometimes, using it at all), takes too much time to refer back to every few questions while you are completing your homework. Whether or not this added time is a real factor, or just an imagined one, was not addressed in this study. Daphne was the only student to refer to this in her interview sessions when she commented that she didn't use the answer keys all the time "because it takes too much time to check your work after". I suspect, based on numerous verbal comments from the students throughout the study, that they felt using an answer key in this way would add too much time onto the homework assignment.

The type of homework related questions that were asked by the students during class were more likely to be process related when they had access to a worked-out key than when they didn't. Instead of the more traditional 'what is the answer to...' question, they asked 'how did you..' or 'why do you..' type of questions. This suggests that access to an answer key that includes the steps required to reach the correct answer may allow academically weak math students to reach a higher level of thinking while doing math, and as a result, learn more from the math that they are doing than they would without access to a worked-out answer key.

Conclusions

The provision of an answer key appears to have increased the likelihood of individual students doing more of their homework (and by extension, completing it) because they could access a key to help them overcome a problem question. In this respect, the answer

keys which included the worked-out steps were much better. Dan commented on this aid in his third interview when he stated "...uh...It gave me the answer and showed me the steps how to do the question (unintelligible) give me the idea how to do the next question after that, and so on." In the same interview, he also commented that he found the homework less frustrating when he had access to an answer key. Sue, in her second interview, agreed that an answer key increased her likelihood of finishing her homework:

- Inter: " ...Did you, ..were you more likely to finish your homework if you had an answer key?"
Sue: "Yeah."
Inter: "Why would that be?"
Sue: "If I didn't have it, and I had some questions I would have just left it, and then asked you for help, or something."

Daphne did point out that it takes individual effort to actually access, and benefit from, an answer key when she stated in the second interview; "I don't know, because it takes too much time to check your work after."

I also found that over the course of the school year, some of the students took great pleasure in pointing out to me the errors in the supplied answer keys. I took this as a very positive behaviour, as it seemed to demonstrate a growing confidence level in the student with respect to specific learned math skills.

With respect to individual students being more (or better) prepared for tests, access to answer keys did not seem to make any difference. Test preparation depends on proper study and review of the material, and answer keys of any kind do not address these skills. The worked-out answer keys could be used as a complete study guide for a student to use in preparation for a test, as they could be referred to while the student is re-doing

questions for the unit homework. Of course, those students who did learn more from their homework as a result of the supplied answer keys are likely to do better on a given test (based on the same material) because they should have a better grounding in the material on which they are being tested. Over the course of the study, recorded marks for homework, tests, and assignments showed that those students who did badly on a given test tended to be the same students who did not complete their homework on a regular basis, and they were also the ones who didn't study for tests (Daphne and Louise).

Daphne's poor grasp of the material over the course of the year continually went against her personal opinion of her abilities - in her interviews, she often commented on how she knew the material, even though her daily scores did not support her beliefs. She demonstrated a need for a much stronger level of learning support than what was available in class. Louise had a high absentee rate, and a very low homework completion rate. She openly commented on numerous occasions that she didn't study for a test, or do an assignment for any number of non-school related reasons. As with Daphne, a much higher level of intervention is required for Louise than could be delivered in a classroom situation at the time of this study.

I believe that the provision of an answer key led to an improvement in the academic performance of all of the students in this study. They all demonstrated a much higher level of self-confidence while accessing an answer key, and they were all much more likely to work independently, or in small groups, without my intervention when they had answer keys to which they could refer.

Between the two styles of answer keys; answers-only, and worked-out answers, the

worked-out answer keys were by a wide margin preferred by the students - they all commented on how that style of answer key allowed them to work through problems without accessing external help. This meant that they didn't give up on their work. The worked-out answer keys were also excellent sources of modeling for Dan, Jake, Daphne, and Sue. As a result, their organizational skills all showed a noticeable improvement over the course of the school year - all of their notebooks became usable as learning aids and their assignments were more completely done. Their notebooks, assignments, and their tests, by the end of the school year, all showed enough 'work' that they were valuable tools for me to use with them (individually) as a teaching tool (when dealing with errors, etc.).

I feel that this study has shown that the use of a descriptive answer key in a mathematics eight class consisting of academically weak students can increase the effectiveness of the assigned homework and general student mastery of the curriculum.

Summary

1. Do academically weak students feel better about their math learning when using answer keys than when not using answer keys? Yes they do. The students repeatedly commented in their responses to various interview questions that they felt that they were learning more, doing more problem solving, and working out their problems a lot more independently when they had access to the answer keys. As a result of these activities, they felt better about the work that they were doing, and about themselves as math students, while they had access to answer keys. This was most evident when the students

were using the worked-out style of answer key.

2. Are answer keys that include the worked-out question a more effective learning tool than answer-only answer keys for academically weak students? Yes they are. The students overwhelmingly preferred the worked-out answer keys to the answer-only answer keys throughout the study. The worked-out keys gave the students information which they could use to effectively self-diagnose and correct their errors. Further, the worked-out keys acted as effective models for the students to use when reviewing their work (for tests), and when doing 'hand in' assignments.

3. Do academically weak students actually use answer keys on a regular basis when they have access to them? Yes they do, although they tend to wait until they have finished their work before they access the keys to check their work. This behaviour limits the value of an answer key as a teaching tool, because the key cannot aid in preventing the student from internalizing incorrect techniques or processes. Even after using these keys for ten months some students in the study still believed that accessing an answer key would be cheating.

4. Do academically weak students model their work after the style shown in worked out answer keys? Yes they do, as demonstrated by the visible improvement shown in the student's notebooks, tests, and assignments over the course of the school year. Even given the obvious effects of maturation and the application of skills presented in other classrooms, I feel that the keys were a significant factor in the improvements I saw in these students.

5. Do academically weak students feel that they learn more (or better) when they have

access to answer keys, both worked-out, and answer-only types, than when they don't have access to them? Yes they do. Again, the student answers to the various interview questions strongly support this conclusion. Every student felt that s/he did a better job of learning (and problem solving) when s/he had access to an answer key. Further, the students felt that they learned the most from their homework when they had access to worked-out answer keys, and their ability to work independently in class increased when they had worked-out answer keys to guide their work.

Finally, the major difference that I experienced with the students in the study was the type of questions that were asked in class about the homework assignments. When there was no answer key, I was asked what the correct answer was, not how do you get the (or any) answer. When the students had answer-only keys, they tended to ask how the answer was reached. When the students were using the worked-out answer keys, their questions were much more likely to be process related than when they had the answer-only style of key. Instead of asking how 'you got' a given number as an answer, the students were asking questions about why a certain operation was used, or their question would relate directly to some foundation skill that was used in the process of reaching the answer. They would ask questions that related one question to another question, in either the same assignment or in a previous assignment, and they tended to refer back to previous questions to demonstrate their thinking processes than when they had answer-only keys from which to work.

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APPENDIX A

List of Interview Questions

“Today is <day and date> and this is the interview with <name>.

You have now completed units of study in math eight that have required you to do homework. You have during this time had one unit without an answer key, one unit with an answer key consisting of the answers only, and one unit with answer keys consisting of the question worked out, showing the proper steps (work) involved in reaching the answer, as well as the answer. I am now going to ask you some questions about your opinions on the three types of homework delivery that you have experienced. Your responses will not affect your mark in this course in any way. Your answers will be used in my research on the use of answer keys for teaching of mathematics.”

1. In which unit of study did you find the homework easiest to do?

-why?

-did having an answer key play a role in this choice? (what type of key?)

-<room for further probes>

2. In which of the three previous units of study did you find the homework the most useful in helping you learn the material presented?

-why?

-<room for further probes>

3. Did you use the supplied answer keys when you did your homework?

-how, why, why not?

-<room for further probes>

4. Did using an answer key affect your learning from the homework?

-how, why?

-which type helped the most/least?

-<room for further probes>

5. Of the two types of answer keys (answer only and worked out), which type did you find most useful?

-why?

-<room for further probes>

6*. Has the use of answer keys changed the way you 'do math'?

7*. Did you use the worked out examples to guide how you did your homework?

*These two questions were added after the first set of interviews was completed.

APPENDIX B

Interview Series Number One:

No answer key, answers-only answer key, and worked out-answers answer key.

Louise

Interviewer: O.K. I'm interviewing Louise and it's January 15th and you, Louise, have now completed three units of study in math 8 that have required you to do homework. You've, during this time, had one unit without an answer key and one unit with an answer key consisting of the answers only and one unit with answer keys consisting of the question worked out showing the proper steps involved in reaching the answer, as well as the answer. I am now going to ask you some questions about your opinions on the three types of homework delivery you've experienced. Your responses will not affect your mark in this course in any way. Your answers will be used in my research in the use of answer keys in Mathematics, Ok?

Louise: Ok.

Interviewer: First question. In which unit of study did you find the homework easiest to do?

Louise: When we had the questions with the answers ... or the work done out 'cause then I'd know how to do it.

Interviewer: ..Alright... So that answers my 'why' – you knew how to do it. Did that answer key have....so that answer key had a role in which unit was easiest to do.

Louise: Yup.

Interviewer: Did you think that helped your learning? Did you learn better because of it?

Louise: Yes because I knew how to do the work.

Interviewer: Ok, in which of the three previous units of study did you find the homework most useful in helping you learn the material?

Louise: The one that we are doing now.

Interviewer: Ok... Did you use the supplied answer keys when you did your

homework? ... The answer keys I gave you, did you use those ones when you did your homework?

Louise: I used them to help me understand stuff.

Interviewer: Good. And did the answer key affect your learning from the homework?

Louise: Did it help me?

Interviewer: Ya.

Louise: Ya.

Interviewer: Ok. Did you do more of your homework when you had an answer key than when you didn't?

Louise: A little bit.

Interviewer: ..A little bit, Ok,. How come?

Louise: 'Cause I understand how to do it.

Interviewer: Alright...And...kind of a repeat question... of the two types of answer keys, which were the answer only and the answer with the work shown, which was the best for you?

Louise: The one with the work shown.

Interviewer: Ok.... Why?

Louise: Because it helped me understand everything.

Interviewer: Good. Thanks very much, that is all I wanted to know.

Louise: Ok.

Interviewer: Did you have any questions for me? Or any comments about the answer key?

Louise: I liked the answer key because it helped me learn.

Interviewer: Right, thanks a lot.

Dan

Interviewer: It's January 15th. I'm interviewing Dan. Ok Dan, you have now completed units of study in math 8 that have required you to do homework. You've, during this time, had one unit without an answer key and one unit with an answer key consisting of the answers only and one unit with answer keys consisting of the question worked out showing the proper steps involved in reaching the answer as well as the answer. I am now going to ask you some questions about your opinions on the three types of homework delivery you've experienced. Your responses will not affect your mark in this course in any way. Your answers will be used in my research in the use of answer keys in the teaching of Mathematics. Ok? Alright Dan, in which unit of study, the first, second, or third, did you find the homework easiest to do?

Dan: Ah...I can't remember but I remember it was... fractions.

Interviewer: Ok, so you found that...why did you find the fractions homework the easiest to do?

Dan: Well if I couldn't figure it out I'd ,.. ah,.. go back and look how the procedure was and then ah,.. compare it with mine and try to fix it.

Interviewer: Ok. So, Did having the answer key available play a role in your choice of which unit was easiest.

Dan: Yup.

Interviewer: Ok. And that was... which type of answer key was that?

Dan: There was a type?

Interviewer: Well you had the answers only and the answers and the answers with the steps....

Dan: Uh,.. the steps.

Interviewer: Ok...in which of those three units of study did you find the homework most useful in helping you to learn the material?

Dan: Uh... what were the chapters. I can't remember.

Interviewer: Ok. Just a sec. Ok,. The three units were the Whole Numbers...Ok, so that was rounding, solving problems, order of operations, substitutions, and variables. The second unit was factors and multiples of number...you had lowest common factors, greatest common factors, lowest common multiples. You had powers and exponents and square roots, and then the third unit was your fractions.

Dan: I think it would be two.

Interviewer: Which would be the greatest common factors and lowest common multiples. Now why did you find the homework most useful in that chapter?

Dan: Uh... I'd never learned some of them before. Like tricks and the ways to do them.

Interviewer: Ok, so the homework helped you practice those?

Dan: Um hmm.

Interviewer: Ok, did having a... you had an answer-only key available in that unit, did that help you homework at all?

Dan: Ya, a bit.

Interviewer: Why?

Dan: Well, I don't know.

Interviewer: Did it... did you, when you looked at the answers, what did you do if you had an answer wrong?

Dan: Fix it.

Interviewer: Ok, how.... or I should say...did you use the supplied answer keys when you did your homework?

Dan: Uh...

Interviewer: Like when I assigned you homework..

Dan: Ya, ya I know what you said, I'm just trying to think.

Interviewer: Ok.

Dan: Ya, I guess so.

Interviewer: Did you use them all the time., some of the time, most of the time?

Dan: Uh, most of the time.

Interviewer: Alright, how did you use your answer keys?

Dan: Wisely –ha ha.

Interviewer: What do you mean by wisely?

Dan: Well I used them the way you are supposed to use them. If I didn't know what I was doing I'd go back and look at them.

Interviewer: Did you check your work? Did you check to see if you had the right answers with them?

Dan: Yup.

Interviewer: Ok. Umm, Did using an answer key affect how much you learned from the homework?

Dan: No.

Interviewer: No, Ok. Why not?

Dan: Well, I know how to do everything,... just I usually just don't write it down right when I'm working.

Interviewer: Ok...

Dan: ..And that's usually what happens.

Interviewer: Would the answer key with the work all shown, would that not help you write out things correctly?

Dan: Yup.

Interviewer: Alright. So, as a final kind of group of questions, of the two types of answer keys – the answers only and the answers with all the steps worked out – which type did you find the most useful for you?

Dan: The one with all the steps written out.

Interviewer: Why?

Dan: Well, I just... sometimes I was completely lost in the work. And I just... I spent a long time working on it and then I went back and checked the steps and tried to do my work that way from the answer key.

Interviewer: Good. Ok. So you liked having It?

Dan: Yup.

Interviewer: Would you want to use them again?

Dan: Yup.

Interviewer: Alright. Thanks very much Dan for your time, I appreciate it. Have a good night. Any questions for me, any comments on the answer keys?

Dan: No.

Interviewer: Ok.. Thank You.

Daphne

Interviewer: Daphne, it's January 16th. You have now completed the units of study in Math 8 that has required you to do homework. You've, during this time, had one unit without an answer key and one unit with an answer key consisting of the answers only and one unit with answer keys consisting of the question worked out showing the proper steps involved in reaching the answer, as well as the answer. I am now going to ask you some questions about your opinions on the three types of homework delivery you've experienced. Your responses will not affect your mark in this course in any way. Your answers will be used in my research on the use of answer keys in the teaching of Mathematics. Ok? In which unit of study did you find the homework easiest to do?

Daphne: I don't know...what did we do? I don't remember.

Interviewer: We did order of operations,...you did rounding...

Daphne: Rounding, that's it. We didn't do rounding...

Interviewer: Ya, you did right at the beginning, and we did some substitution. That was one unit. And then you did greatest common factors and lowest common multiples and exponents and square roots and powers

Daphne: That was the easiest one.

Interviewer: Ok,...why?

Daphne: I knew that the best how to do it.

Interviewer: Did you know it the best when you came into the course or did you learn

it?

Daphne: I learnt it better how you taught it step by step.

Interviewer: Ok. What about the last one we did, the fractions. How did you find that?

Daphne: Easy.

Interviewer: It was easy, Ok,.. but, not as easy then as greatest common factors, or easier?

Daphne: Easier.

Interviewer: Easier. Ok.. Why?

Daphne: I don't know. 'Cause you didn't have to find the denominator or whatever.

Interviewer: O.K. In you choice that you just did about the easiest unit did having an answer key help make the unit any easier or harder?

Daphne: Kind of because you could check you work after you did it to see if you got it right and then you could go to school with it all right.

Interviewer: Because of that did you ever have any questions that you knew you wanted to ask when you came back to school.

Daphne: Yeah.

Interviewer: Ok. Did that help you learn better?

Daphne: Yeah

Interviewer: In those three units that we did, which of those three did you find the homework the most useful?

Daphne: Um, the fraction unit.

Interviewer: Why did you find that?

Daphne: I don't know. I just find fractions more easy than anything else.

Interviewer: Ok. When you were doing your homework did you use the answer keys that you were given?

Daphne: Sometimes, Ya.

Interviewer: When you say 'sometimes',..when would you – or when wouldn't you?

Daphne: When I know when I'm getting something wrong and I'm doing the wrong thing. When I'm dividing or something and I know I'm getting it wrong I just check it over and I know what I'm doing wrong.

Interviewer: How do you know when you are doing your work that you are getting it wrong?

Daphne: Just the steps I do and I know its... like by the steps you take on the board and the ones I do, I know I'm getting it wrong 'cause it's way different than you doing it.

Interviewer: Alright. Did using an answer key affect your learning from homework?

Daphne: Not really.

Interviewer: No? Ok, why not?

Daphne: I don't know. Its just better with the answer key.

Interviewer: It is better,.. how?

Daphne: Because when you are done your can check it over and then when you go to school you can know what steps you do and stuff.

Interviewer: Alright. When you used the answer keys did you look at the right answer after every question or did you look at it when you finished the homework?

Daphne: When I'm done the whole page, like, everything I have to do.

Interviewer: Ok.. If you found you got a bunch wrong did you go back and re-do them?

Daphne: Yeah.

Interviewer: Ok.. Um, of the two types of answer keys you had, there was just the answer only and the other one with it all worked out, which one did you like best?

Daphne: I liked the one with just the answers.

Interviewer: Why?

Daphne: 'Cause then you can work it out by yourself and keep on working it until you know how to do it and get the right answer.

Interviewer: Oh, alright. That's cool. Did you have any questions or comment about the answer keys?

Daphne: I just think they are better – just the ones that had just the answers.

Interviewer: Ok,... that would be your choice then if you could choose.

Daphne: Yeah.

Interviewer: You'd take the one with just the answer. Ok. Well, that's it. Thanks very much for your time. Have a nice weekend.

Daphne: Thank you.

Jake

Interviewer: OK. January 19th. This is an interview with Jake. You have now completed the units of study in math 8 that has required you to do homework. You've, during this time, had one unit without an answer key, one unit with an answer key consisting of the answers only and one unit with answer keys consisting of the question worked out showing the proper steps involved in reaching the answer, as well as the answer. I am now going to ask you some questions about your opinions on the three types of homework delivery that you have experienced. Your responses will not affect your mark in this course in any way. Your answers will be used in my research on the use of answer keys in Mathematics. Excuse me I'm going to close this door. There Ok. So, in which area of study did you find the homework easiest to do?

Jake: Uh, the second one we did..

Interviewer: That would be the one on...

Jake: The answer keys.

Interviewer: Factors and lowest common multiples...

Jake: Yes.

Interviewer: Why is that?

Jake: Well it just helped me – the work that was shown on the pages helped me

understand it. Like uh, basically it's a lot easier than calling you and asking you if I need help or not.

Interviewer: The... that unit didn't have the work shown. That, that answer key was just the answers only.

Jake: I know .

Interviewer: Ok.

Jake: And it just... I could check over it and I could always find my mistakes.

Interviewer: Ok.

Jake And that time I could just... there is only a few I made on this page...

Interviewer: Alright.

Jake: Just stupid, I mean, just stupid mistakes.

Interviewer: We are all allowed to have stupid mistakes. Ok,...ummm...in which of the three units of study did you find that the homework was the most useful in helping you learn the material that was being presented.

Jake: Uh, actually can you say that again..

Interviewer: Sure. Uh, in which of the three units of study did you find that the homework was the most useful in helping you learn.

Jake: On the answer key?

Interviewer: No, the homework Just the homework. You had three units of study and in which of those three was the homework the most useful in helping you learn the material being presented.

Jake: What was the three units... there were the factors...

Interviewer: There's,..the second was the factors and common multiples, and square roots and powers. The first unit was order of operations, adding, subtracting, dividing. Umm, and problem solving in there. And the last one was...ummm, was Fractions.

Jake: Uh, probably the first one.

Interviewer: Ok....So that's...

Jake: That one could help me easier by knowing which... what to do first. Like the uh, order of operations.

Interviewer: Uh huh.

Jake: Instead of making a mistake by doing the wrong one first.

Interviewer: Ok. Alrighty....Um, why in the first one did you find, um, the homework most useful. What about that homework?

Jake: It was...I told you that...its just the, it was just the order of operations – how to do it.

Interviewer: Oh. Ok....Alrighty. Um, did you , did having an answer key available– now you didn't have one for that unit – do you feel that having an answer key available makes the homework more useful in learning?

Jake: Oh, yeah.

Interviewer: Ok,...um,.. when you were doing your homework, did you use the answer keys that were provided?

Jake: Yeah, most of them.

Interviewer: Alright. Um, how did you use them? Could you describe to me how you would use the answer keys when you were doing your homework?

Jake: When I get home I first, like, I do math first and then when I'm totally done I check over it with the answer key. And sometimes I just make stupid mistakes, like uh, not lowering the, like um, to not lower to the lowest form in fractions and stuff like that.

Interviewer: O.K. Did you then go back and make your corrections?

Jake: Oh yeah.

Interviewer: Alright. Um, did using the answer key – did using any of the types of answer keys affect how you learned from your homework?

Jake: I guess I got used to it like, um, Like I got used to lowering it to form and the lowest... lowering it to lowest form .

Interviewer: Ok.

Jake: And, just uh, it just made me practice it a bit more and just made it a lot easier.

Interviewer: Alright. Now of the two types of answer keys, the answers only, and then the ones with the work all worked out – all the steps shown, which type do you find the best for you?

Jake: The work.

Interviewer: And why is that?

Jake: 'Cause like instead of just the answer one, it doesn't really uh, it doesn't explain it. It doesn't explain how to do it.

Interviewer: Ok. Did you use the ones with the answer keys worked out, do you, when you got stuck did you use them to learn how to do the stuff.

Jake: Oh, Yeah I looked at them to learn how to do it.

Interviewer: Alright. Ok. Do you have any comments you want to make about the homework – about the answer keys at all?

Jake: Not really. Like I noticed some of the mistakes that you made....

Interviewer: Ya, ya, which was good. Did you find noticing mistakes helped you learn?

Jake: Hum, I don't see how.

Interviewer: Did it make you feel better about your work, knowing that you got it right?

Jake: Yup.

Interviewer: Ok...Um, Would you, would you consider with the answer keys going - and after you've done one or two questions- going and looking at the answers instead of waiting until the end to look at them?

Jake: Uh, just the work part. Not the answers – No. Just how to do it. Like if I got it right Ya. (unintelligible).

Interviewer: Ok.

Jake: (unintelligible)

Interviewer: Alright. But you would look at it to see the work if you were getting stuck.

Jake: Ya.

Interviewer: Alright. Ok. No other comments you wanted to make?

Jake: No.

Interviewer: Ok. Thanks very much. Have a nice day.

Jake: Yup.

Sue

Interviewer: It's the 19th of January and this is an interview with, of course, Sue. You have now completed the units of study in math 8 that have required you to do homework. You've, during this time, had one unit without an answer key, one unit with an answer key consisting of the answers only and one unit with answer keys consisting of the question worked out showing the proper steps involved in reaching the answer as well as the answer. I am now going to ask you some questions about your opinions on the three types of homework delivery that you have experienced. And, your responses will not affect your mark in this course in any way. Your answers will be used in my research on the use of answer keys in teaching Mathematics. Ok? So, in which area of study did you find the homework easiest to do?

Sue: Okee Dokee.

Interviewer: So, in which unit of study did you find the homework easiest to do?

Sue: (unintelligible)

Interviewer: We've had three units of study so you had one without. Ok. that was, um, order of operations, adding, subtracting, multiplying and problem solving. You had, um, greatest common factors and lowest common multiples, square roots and powers – with just the answer only. And then you had, the last one was um, fractions, working with fractions – and that was worked out, all the work was worked out plus the answers.

Sue: The last one.

Interviewer: The last one. That would be the fractions.

Sue: Yup.

Interviewer: Ok. Why did you find the homework easiest to do in that unit?

Sue: Because it showed you the steps.

Interviewer: Ok. Um, I assume then, that having an answer key is why it was easiest – it had a role in your choice. Ok. How did you, how did you use that answer key? How did you use it when you were doing your homework?

Sue: I'd do... the steps and then I'd check to see if I got it right.

Interviewer: Ok. And if you didn't get it right, what would you do then?

Sue: Erase it and then study the answer key to see how they got the answer.

Interviewer: Ok. Good. Good for you. Um, in which of those three units of study did you find the homework most useful in helping you learn the material that was being presented?

Sue: What?

Interviewer: Tricky question. In the three units, in the three units you had, in which one of those was the homework best at helping you learn the material?

Sue: unintelligible.

Interviewer: Did the homework help you learn the material at all?

Sue: Ahhhh.

Interviewer: Ok. Um, if you had to go and re-do any of the units, which one do you think, um, which one do you think... would... the homework would help you get the best mark?

Sue: (unintelligible)

Interviewer: You're not sure? Ok. Um, I'll re-word the question. Was there one of the units where the homework didn't help at all?

Sue: No.

Interviewer: Ah, so it helped you a little bit. Good. Alright. Um, did you use the answer keys when you did the homework?

Sue: Ahhhh...

Interviewer: Alright. Can you describe...

Sue: When I got it.

Interviewer: Ha, Alright, that's a good comment. Can you tell me how you used it? When you'd go home and you'd 'got it' there, how did you use your answer key?

Sue: I'd do my homework first and then I'd check it over.

Interviewer: Alright. When you checked it over, if you found a question you did wrong, what would you do then?

Sue: Erased it, looked at the answer to see how they got it and then I'd figure it out.

Interviewer: Ok... Um, and was it easier with the questions worked out than it was with the answers only?

Sue: Yes.

Interviewer: Alright. Um, do you think that having that answer key, either one, made the home.. made... helped you learn better?

Sue: Umhum.

Interviewer: Ok. Which of the two types do you think helped you learn best?

Sue: The one with the answers...

Interviewer: Why...

Sue: (unintelligible) The one that shows it worked out and then the answers.

Interviewer: Ok... Why is that?

Sue: 'Cause it shows you how they got the answers.

Interviewer: Alright, Good. Um, that actually answers the next question too, which is

which of the two types of answer keys did you find the most useful?

Sue: The one with the answer that helped -that worked it out and then the answer.

Interviewer: Alright, Um, thanks Sue, Do you have any comments, any things you'd like to say about the answer keys?

Sue: hmpf.

Interviewer; Alright. They are a good thing?

Sue: Aaaa.

Interviewer: Ok. Good. Thank you very much. Go play basketball!

APPENDIX C

Interview Series Number Two (questions added):
Answers-only answer key, worked-out answer key, and no answer keys.

Louise

Interviewer: Hi, lets just make sure this thing is working,... ok interview 2. This is Louise. Hi Louise, you now, today is April 9th, you've now completed units of study in Math 8 that have required you to do homework. You've during this time had one unit without an answer key, one unit with an answer key consisting of the answers only and one unit of the answer keys consisting of the question worked out showing the proper steps involved in reaching the answer, as well as the answer itself. I'm now going to ask you some questions about your opinions on the three types of homework delivery you've experienced. Your responses will not affect your mark in this course in any way and your answers will be used in my research on the effects of answer keys on the learning of mathematics. So, question number one. In which unit of study did you find the homework easiest to do?

Louise: The one with the answer key that shows you how to work it out.

Interviewer: Alright, now by do you mean like answer keys with the answer all worked out?

Louise: Yeah.

Interviewer: 'k', did you think you did better because of that?

Louise: Sort of, not really.

Interviewer: Do you,..why 'not really'?

Louise: I don't know, I didn't understand it. I think it showed me how to do it, but I still didn't understand it.

Interviewer: Did you come in and ask for extra help?

Louise: No.

Interviewer: Ok. number two. Um, in which of the three units of study did you find the homework most useful in helping you learn the material? So that was the...

Louise: This last one.

Interviewer: The last one, ok, and why was that?

Louise: I don't know, it just was easier.

Interviewer: Just easier..

Louise: I know more stuff

Interviewer: Alright... ah... number three. Did you use the supplied answer keys when you did your homework?

Louise: I... did not (unintelligible) I just checked back sometimes if I didn't (unintelligible) if it was really wrong or something

Interviewer: Alright,..um..what, how did you decide whether you felt your answer was right or wrong?

Louise: Well just the way the work was done out and like sometimes I calculate it and calculate it and I'd come up with the wrong answer so I know my work was wrong,.. that I had the wrong answer.

Interviewer: Ok you knew you had the wrong answer because you were looking at the answer key.

Louise: Yeah.

Interviewer: Alright... ummm... did using an answer key, did it affect your learning from the homework?

Louise: Not really.

Interviewer: Ok,... um... which type of answer key do you thought, do you think, had the most or the least effect on your learning – the one where it was all worked out, or just the answers only?

Louise: Um,..the one where it was all worked out.

Interviewer: Did that help you the most or the least?

Louise: The most.

Interviewer: ... That actually answers question number five as well... did you have, did you want to say anything about the answer keys – you've been through them twice..like..

Louise: Ok, I just think like it'd be better if you have the answer key where it tells you how to work it out and (ok) what to do, instead of just having the work, cause some people could like just go and copy it down or something.

Interviewer: Alright, so you having all the work there, did you copy it all out at any time?

Louise: No.

Interviewer: But you think others might.

Louise: Yeah.

Interviewer: Ok. would it be easy if you had it told you how to do it do you think it would be easy for you to follow the directions than it would be to just to look at the work and...

Louise: No.

Interviewer: And model it, ok.

Louise: I like um, the answers, I just like 'em, its easier.

Interviewer: Well that's good, ok. well thanks very much Louise, That's it, that's it for this interview.

Jake

Interviewer: Alright, lets just test this to make sure .. does it actually work.

Alright, interview oh, number two, its April 27th and its with Jake. Ok hi Jake, you've now completed units of study in math 8 that have required you to do homework. Ah, You've during this time had one unit without an answer key, one unit with an answer key consisting of the answers only and one unit of the answer keys consisting of the question worked out showing the proper steps involved in reaching the answer, as well as the answer. I'm now going to ask you some questions about your opinions on the three types of homework delivery you've experienced. Your responses will not affect your mark in this course in any way. Your answers will be used in my research on the effects of answer keys on the learning of mathematics. They're all the same questions you had before, with two additional ones, ok?

Jake: (unintelligible)

Interviewer: Ok Jake, in which unit of study did you find the homework the easiest to do?

Jake: Um, the easiest one like work-wise or answer key-wise?

Interviewer: Um,..

Jake: Which unit was easier..

Interviewer: I'll say, lets start with work-wise first.

Jake: Oh, work-wise I what did we do like which...

Interviewer: We went to the measurement unit which was, we had perimeter, which no answer key, you had area and volume, or sorry, perimeter with answers only, area and volume were worked out, and then the integers there was no answer key.

Jake: I think the measurement was easy, um the area.

Interviewer: Did the, why?

Jake: I could do it in my head really easily and the work was pretty good, I could do it pretty fast.

Interviewer: Ok, did the ah answer key have a role in that choice of which unit?

Jake: Ah was the area one with the with the answers worked out?

Interviewer: Yep.

Jake: Yeah I liked that one better cause, I wish I'd had it for the integers to cause I could understand it easier with the work.

Interviewer: Alright, good, that a good answer. ok, um,.. how did you find those answer keys – how did they made it easier?

Jake: 'Cause it shows the work answer, like not just the answer part, like how the work was shown.

Interviewer: Ok,..um,..having the answers worked out then did it help you understand what you were doing?

Jake: Yep

Interviewer: Yes, ok.. In which of the three, those three previous units of study did you find the homework the most useful in helping you learn the material?

Jake: Aaaa,...again, I guess the area.

Interviewer: And why is that?

Jake: 'Cause they deal with more numbers.

Interviewer: How do you mean?

Jake: Like aaa, more equations, like base, area, height, (unintelligible)

Interviewer: And now, again that was one of the ones where you had the worked out answer keys so it was that was a factor then?

Jake: Yeah.

Interviewer: Ok,...um,... did you use them, the answer keys, the supplied answer keys while you were doing your homework?

Jake: Aaa, not while I was doing my homework, like most of the time, some times I forgot to do them but, um,..yeah, after I was done my homework I'd just check 'um not while I was doing it. Every so often I would have questions and I make myself look at the answers (um) to see if I got 'em wrong and change them.

Interviewer: So if you got 'em wrong you'd go back and change them again?

Jake: Yeah.

Interviewer: Did you then, um, when they were worked out did you go and look to see where your mistake was?

Jake: Yes.

Interviewer: Did that help you not make that mistake again?

Jake: Yep.

Interviewer: Good.

Jake: Um,...

Interviewer: Then did using an answer key do you think using an answer key affected your learning from homework?

Jake: Ah, I guess you could.

Interviewer: How?

Jake: Uh, It depends on where you put your marks on, like work shown, or just answers right.

Interviewer: Not so much where marks go, how you learn from doing homework.

Jake: Oh.

Interviewer: So it did help you learn from homework?

Jake: Yeah...

Interviewer: Did having again the worked out answer keys improve the use of homework?

Jake: Yep

Interviewer: Ok, ..um..so..ah..let me rephrase that. Did using an answer key affect your learning from the homework, you said yeah. Which type of answer key helped the most?

Jake: The work shown.

Interviewer: The work shown, and why was that?

Jake: 'Cause, cause I could understand it faster, and a lot easier. I could look up my mistake, what I did wrong, and change it and then in the future I didn't make that mistake again.

Interviewer: Ok. am,... so then, of the two answer types, two types of answer keys, the answer only and the worked out answer keys, which type did you find the most useful?

Jake: The worked out.

Interviewer: And you've already stated why. um,... has the use, has using answer keys changed the way you do math?

Jake: Like in what way?

Interviewer: Has it changed the way you set up your work, or do your answers, or learn from your homework in any way?

Jake: Yeah (unintelligible) a lot.

Interviewer: Alright, can you describe how then using answer keys has changed?

Jake: Well, see, I've, like, um, I was doing an area of a cylinder, and um, I'd get the answer and I did all the work and everything, and I'd check it out and it was wrong, then I'd looked, I'd kept looking at the pages to see what I did wrong, like I, ... like I looked, ... I looked over my equation, like I went back over it step by step again.

Interviewer: Ok, like, ...so you didn't do that before when you were checking your work.

Jake: Sometimes it was just a stupid mistake like putting the wrong number down, say a '2', and (unintelligible).

Interviewer: When, before you were using an answer key did you ever check your homework in any way?

Jake: Um, ...sometimes I did, ... like on really hard, ...ah, ...pages..

Interviewer: Where would you check your work?

Jake: Uh, ...in my work, ... like I just went over it a couple of times. Like I did the equations like, ... two or three times, or stuff like that.

Interviewer: Alright, but you wouldn't really know whether you were getting the right answer or not.

Jake: No.

Interviewer: Ok ..um..Do you think that makes you, does having an answer key make you feel more confident doing math homework?

Jake: Yes.

Interviewer: Alright. so do you feel better then?

Jake: Yeah.

Interviewer: Alright... um.. Did you ever use the worked out examples in the answer

key to guide you when you were doing your homework to show you what to do next?

Jake: Oh yeah, lots of times, most of the time.

Interviewer: Would you say then that it or let me rephrase that,.. Did having access to worked out examples help you learn math?

Jake: Yeah.

Interviewer: Ok. ... Thanks very much Jake, that's it for this set of interviews. I appreciate it, we have one more to go before the end of the year.

Jake: Oh yeah.

Interviewer: Any other, did you have any other, want to add anything before we end?

Jake: Ah,... no.

Interviewer: Thanks a lot.

Daphne

Interviewer: Interview two, we'll just make sure everything is still working,... hi Daphne, um,..you've now completed units of study in math 8 that have required you to do homework. You've during this time had one unit without an answer key, one unit with an answer key consisting of the answers only and one unit with the answer keys consisting of the question worked out showing the proper steps involved in reaching the answer, as well as the answer. I'm now going to ask you some questions about your opinions on the three types of homework delivery you've experienced. Your responses will not affect your mark in this course in any way. Your answers will be used in my research on the effects of answer keys on the learning of mathematics. They're all the same questions you saw before, with two additional ones added at the end, ok? So, in which unit of study did you find the homework easiest to do?

Daphne: Um,..what do you mean,...like,..what,..with the answer key?

Interviewer: Well you had, you had, um,..measurement and you had um, the volume you had the answer keys worked out I believe it was, and you had area was the answers only.

Daphne: I think it was the volume I think?

Interviewer: Why?

Daphne: 'Cause it was easy.

Interviewer: What made it easy?

Daphne: I don't know, I just think volume is easy.

Interviewer: Ok... did having an answer key have a role in your choice of which was easiest?

Daphne: Yeah

Interviewer: And why was that?

Daphne: Because when you have an answer key, and when your done your work you can check up your work after you're done.

Interviewer: Alright,... did you do that on a regular basis?

Daphne: Not really.

Interviewer: Why not?

Daphne: I don't know, because it takes to much time to check your work after.

Interviewer: Ah... ok, that's a good answer. Um,..in the, in the last three units of study which, in which one did you find the homework most useful in helping you learn the material presented?

Daphne:Ahhh,... I don't know. ... I don't know (unintelligible)

Interviewer: That's an ok answer actually. I don't know,... um,... think think think, how do I go from here because I know what I want to ask.... alright, um,..therefore did did different types of answer key have no effect on how easy it was to learn, or how much you learned?

Daphne: ... Uh, not really.

Interviewer: Ah which type of answer key did help you the most?

Daphne: I like the ones that just have the answers.

Interviewer: Ok.

Daphne: Because then you can work out the problems yourself and keep on figuring out where your mistake was.

Interviewer: Alright. ...ah..um, did you use the supplied answer keys when you did your homework?

Daphne: Sometimes....

Interviewer: Why only sometimes?

Daphne: I don't know,...I just do my homework and I just never do my answer key thing.

Interviewer: Did... when you used the answer keys,..did it affect how much you learned from your homework?

Daphne: No.

Interviewer: Why not?

Daphne: ...I don't know,...I think,...I don't know,...I can't think,...

Interviewer: Ahhh,... um,..did you, you've already stated that you preferred the answer only type.

Daphne: Umhum.

Interviewer: When you had the answer key with all of the answers worked out, did you ever look at those to see how to get the answer?

Daphne: Sometimes yeah.

Interviewer: Did you .. use the worked out ones to um model your own work after, to help learn the steps? Did you find that useful?

Daphne: Yes.

Interviewer: Did you, after using that, did you think, feel that you were more confident doing that particular exercise?

Daphne: Yeah.

Interviewer: Alright....ah.....you've already answered the question about the two types

of answer keys and which one you found more useful. You said it was the answers only. Um, did using answer keys change how you did your math in any way?

Daphne: Yeah.

Interviewer: How?

Daphne: It, I don't know, because when ya...you have your answer key and you do your work you can check it over and if you have it wrong you could keep on figuring out how to do it and you learn more about that.

Interviewer: Alright

Daphne: How to do it, well I do

Interviewer: Did you use the worked out examples to guide how you did your homework?

Daphne: Kinda, sometimes.

Interviewer: Give me an example of when you would have.

Daphne: Like when in the book when you have the answers and you don't get how to do it then you look at the model and see how you set it up.

Interviewer: Did that make your homework less frustrating?

Daphne: Yeah.

Interviewer: Alright, were you are you more likely to do your homework if you've got an answer key?

Daphne: ... Yeah, I think so. Sort of.

Interviewer: Tough one to answer.

Daphne: Yeah (laughs).

Interviewer: Alright. that's it. Have you got any comments to add?

Daphne: ..No.

Interviewer: No?..Um.. no thoughts on using the different types of answer keys that

you've had?

Daphne: Just that the ones with the no, like the ones just with the answers I think that that's better.

Interviewer: Ok, that will be used, I will make comment about that.

Daphne: I think so, good.

Interviewer: And, and you said because you can...

Daphne: Do it yourself.

Interviewer: Do it yourself.

Daphne: Keep on doing it.

Interviewer: Keep on doing it. alright, thanks very much Daphne.

Dan

Interviewer: Dan, its May 4th, you've now completed units of study in math 8 that have required you to do homework. You've during this time had one unit without an answer key, one unit with an answer key consisting of the answers only (PA sounds) and one unit (PA sounds) of the answer keys consisting of the question worked out showing the proper steps involved in reaching the answer, As well as the answer. I'm now going to ask you some questions about your opinions on the three types of homework delivery you've experienced. Your responses will not affect your mark in this course in any way. Your answers will be used in my research on the effects of answer keys on the learning of mathematics. They're all the same questions you had before, with two additional ones added in. So the units of study we had you had measurement, perimeter, area, volume and integers. And perimeter was answers only, area and volume were worked out, and the integers there was no answer key. So which of those units of study did you find the homework the easiest (PA) to do?

Dan: Um,... probably integers.

Interviewer: And why is that?

Dan: Well, I just kinda like showing my work and then, like, doing it myself kinda thing.

Interviewer: So, not having an answer key you found a good thing.

Dan: Yeah.

Interviewer: Alright,... um, obviously did the answer key play a role in that you liked the integers the best?

Dan: It kinda actually it helped me out and so.

Interviewer: 'K, now remember that

Dan: To see if I was doing it correctly or not.

Interviewer: Now remember this is the section on integers where you didn't have the answer key.

Dan: Yep.

Interviewer: ... In those three units of study then, which, this is a slightly different question, which did you find the homework most useful in helping you learn the material?

Dan: 'K, There was...

Interviewer: Perimeter, area, volume,...

Dan: Um,..easiest or hardest?

Interviewer: Which did you find homework most useful...

Dan: Um,..area.

Interviewer: Area, and why would that be?

Dan: ... I just found easier, a little bit.

Interviewer: ... Did you use the ah,.. answer keys when you were doing area?

Dan: Yep.

Interviewer: Ok,... ah,.. when you were doing your homework did you use the answer keys a lot, or a little?

Dan: A little....

Interviewer: ... Why only a little?

Dan: I didn't feel like I absolutely had to have it.

Interviewer: Ok....That's an interesting answer. ah...um... Why did you not feel you absolutely had to have it?

Dan: Ah..I just kinda like doing my work on my own sometimes an' with no help of an answer key. And wait and see whether I got it right or not.

Interviewer: Couldn't you do that by looking at the answers in the answer key once you've done your homework?

Dan: Uhuh.

Interviewer: And then you could go back and correct it?

Dan: Yeah.

Interviewer: You didn't think about doing that?

Dan: No.

Interviewer: Ok,...ah,..does having an answer key, did using an answer key affect your learning from the homework? Do you think it affected your learning from the homework?

Dan: ...Ah...it prevented most mistakes. So that I guess that it might, helped quite a bit.

Interviewer: Which type of answer key helped the most?

Dan: The one with the work.

Interviewer: Did you model your work after that? In other words, when you had the sheet in front of you with all of the steps worked out did you make your work look like that?...Did it guide you in how you did your work?

Dan: Yes.....sort of like that.

Interviewer: Ah... Would you like to have access to that type of homework key all the time?

Dan: Yep.

Interviewer: ... That sort of answers the next question too... ah..um..using the answer keys, has it changed the way you do math?

Dan: ... Yep..

Interviewer: How?

Dan: Like formulas an,..the way I write it down and how I just kinda mind to the question, how to do it.

Interviewer: Ok.... Will you continue to write down things like starting with writing down formulas in the future now that you've started doing it?

Dan: Umhum...

Interviewer: Ahum..Did you use the worked out examples to guide how you did your homework?

Dan: Yeah....

Interviewer: And did you find that useful?

Dan: Uhhuh.

Interviewer: ... Did you find ..um..did you find the homework less frustrating if you've got access to an answer key?

Dan: Oh yeah.

Interviewer: Ok, good. Do you have any other comments you'd like to add?

Dan: No, other than sometimes I have a hard time reading your writing, but that's cause your doing it all at night.

Interviewer: That's the truth.

Dan: (laughs)

Interviewer: If we were going to do this formally, we'd get it all typed out. Good, thanks a lot, I appreciate it. One more to go.

Sue

Interviewer: Ok, today is ah, May 5th, and this is an interview with Sue, interview two. Ah,..you've now completed units of study in math 8 that have required you to do homework. You've during this time had one unit without an answer key, one unit with an answer key consisting of the answers only and one unit with answer keys consisting of the question worked out showing the proper steps involved in reaching the answer, as well as the answer. I'm now going to ask you some questions about your opinions on the three types of homework delivery you've experienced. Your responses will not affect your mark in this course in any way. Your answers will be used in my research on the effects of answer keys for teaching mathematics. The questions your going to here are all the same as you had before, with the addition of two new ones at the end, alright?

Sue: Oh yeah.

Interviewer: Ah, Sue, in which unit of study, that would be in the measurement we had perimeter, area, and volume then we had integers, and in that, which of those units of study did you find the homework easiest to do?

Sue: ..Perimeter.

Interviewer: Why was that?

Sue: 'Cause, like there was only a couple of steps in it.

Interviewer: Oh, That's a good one. Ok. ..Did having an answer key have any role to play in your choice of which was easiest to do the homework in?

Sue: No...

Interviewer: ..It was then, it really was just that there were fewer steps when doing the perimeter.

Sue: Yeah.

Interviewer: What happens then when there are more steps?

Sue: And then it could get more confusing sometimes.

Interviewer: A bit?

Sue: Sometimes I'd get all screwed up.

Interviewer: I can relate to that. ..In which of the three previous units of study did you find the homework the most useful in helping you learn the material that was presented?

Sue: Um.....volume.

Interviewer: Volume. why was volume the most useful?

Sue: 'Cause I got screwed up on some of the questions and it was kinda hard to understand (unintelligible) and it helped.

Interviewer: Alright, so it was beneficial then? ..Do you think then... that the answer key then,... how do I word this... do you feel then that the volume unit, that having an answer key helped you learn better?

Sue: Yeah.

Interviewer: Ok. ..Did you use, did use the supplied answer keys when you did your homework?

Sue: Umhum.

Interviewer: Did you use them on a regular basis, or just sometimes?

Sue: Sometimes.

Interviewer: When you're doing your homework, can you describe to me how you used the answer keys?

Sue: ..If I had it wrong then I'd just look at it and see if I could do it the way it was in the answer key.

Interviewer: How did you know when you had the question wrong?

Sue: I checked it.

Interviewer: With the answer key?

Sue: Yeah.

Interviewer: Did you check every question or every couple of questions?

Sue: Every couple of questions.

Interviewer: Ok, who, did you come up with that idea or did someone suggest it?

Sue: I just came up with it.

Interviewer: ...Does it work?

Sue: Yeah.

Interviewer: ... Ah,...did...did that help .. doing it that way?

Sue: Yeah.

Interviewer: ... Alright...Did using an answer key affect your learning from homework?

Sue: Uhuh (no)

Interviewer: It didn't help you learn any better?

Sue: It helped a bit,... on the steps,..

Interviewer: Ok,..how did it help? What type of help did it give you?

Sue: Um,..what specific thing you're supposed to do for each step.

Interviewer: Alright... anything else?

Sue: No.

Interviewer: ...Did you ..were you more likely to finish your homework if you had an answer key?

Sue: Yeah.

Interviewer: Why would that be?

Sue: If I didn't have it, and I had some questions I would have just left it, and then asked you for help or something.

Interviewer: Alright... Which of the two types of answer keys you had – the answers only and the worked out as well as the answers – which type did you find the most useful?

Sue: The ones where I had the answers worked out.

Interviewer: ...And that was because...

Sue: It showed you how to do it,..properly.

Interviewer: One of the proper ways anyway. Using the, has the use of answer keys changed the way you do math?

Sue: Not really.

Interviewer: No...do you ah,..when you do your homework are you more careful to write out the steps

Sue: Yeah.

Interviewer: Ah,..is that because of the answer keys, is that because of what is happening in class, is that because of your classmates?

Sue: ...I just write it out.

Interviewer: Have you always done it that way?

Sue: (unintelligible) If it is really easy I just write the answer out (unintelligible)

Interviewer: And you've always done that?

Sue: Yep.

Interviewer: Ok,..ah, did you use the worked out examples to guide how you did your homework?

Sue: Uh-huh.

Interviewer: ...Did you use it a lot?

Sue: Sometimes.

Interviewer: ...Did you have anything you wanted to add?... comments about the answer keys? ...About the units?

Sue: Nope.

Interviewer: ...Ok., Thanks very much Sue, that's all.

APPENDIX D

Interview Series Number Three:

Worked-out answer keys, no answer keys, and answer-only answer keys.

Louise

Interviewer: Alright, does this tape actually work for interview section three let's find out (cough). Good morning Louise this is your last and final interview, um, so thanks very much for taking part in my little project. Let's see what happens. Ah, these are the same questions that you've had before. You've completed three units of study in Math eight that have required you to do homework. During this time you've had one unit without an answer key, one unit with an answer key consisting of the answers only, and one unit with an answer key consisting of the answers worked out showing the proper steps involved in reaching the answer, as well as the answer. Um, number one, in which unit of study did you find the homework easiest to do?, and that would be algebra, which was our last unit was answers only, we did integers-multiplying and dividing, as well as all operations with no answer keys, and you did adding and subtracting integers with answer keys with all the worked out steps.

Louise: Adding and subtracting with the worked out steps.

Interviewer: Why did you find it the easiest to do?

Louise: Because it helped you a lot, more than all the other stuff.

Interviewer: So it was the answer keys not the topic that was easiest?

Louise: The other topic was easy, and the answer key helped me too.

Interviewer: Alright.... In which of those three previous units of study then did you find the homework most useful in helping you learn the material?

Louise: The one with the written out answer key.

Interviewer: Integers, adding and subtracting.

Louise: Yeah.

Interviewer: And it was because the answers were worked out, or was it because the unit was easy?

Louise: Um, the answers were worked out so it was easier for me to understand it, and it was sort of easy too.

Interviewer: Alright.... Did you use the supplied answer keys when you did your

homework?

Louise: Yep.

Interviewer: Did you use them on a regular basis?

Louise: Um,..I think after my work, or half way through. (unintelligible)

Interviewer: Ok....That seems pretty regularly.... Did using an answer key affect your learning from the homework?

Louise: I don't know,...

Interviewer: That's an honest answer. um.. Which type of answer key helped you the most or the least?

Louise: Um,.. (unintelligible) the most, I don't know which one helped me the least.

Interviewer: Alright.... Why did you find, ah, ... or what would you describe as the biggest difference with the answer key all worked out and just the answers only?

Louise: When its all worked out it sort of helped you 'cause it sort of like, like tells you the steps and if you do a step wrong you can look back and see what step it was.

Interviewer: Good answer, very clearly explained.... Did using answer keys change the way you do math?

Louise: I don't know, I don't think so.

Interviewer: Did it change the way, did it change the questions you asked?

Louise: Sort of,..

Interviewer: How?

Louise: 'Cause, well like, if I had to ask you how to do it, then yeah, I knew how to do it.

Interviewer: (sound) .. Did you use the worked out examples to guide you when you were doing your homework at all?

Louise: Not really..

Interviewer: In other words .. Did you look at it as you were doing your question to see what you had to do next?

Louise: Aaa...no. I just waited 'til I was done, then I looked back.

Interviewer: Did you wait until you were done all of the questions, or did you do it every, did you check every couple of questions?

Louise: I think every couple.

Interviewer: Ok, thank you very much Louise, that's all for me and that's all for you.

Dan

Interviewer: Morning Dan, you've now completed three units of study in Math 8 that have required you to do homework. You've during this time you've had one unit without an answer key, that was um..doing integers multiplying and dividing and all operations. You had one unit with an answer key consisting of the answers only, that would be algebra, and you had one unit with worked out answer keys, and that was adding and subtracting integers. Now I'm going to ask you the same questions you've been asked before. So, first question, which unit of study did you find the homework easiest to do?

Dan: Aaa Did we have .. the answer key for integers?

Interviewer: We had, you had part of integers you had no answer key and the adding and subtracting integers you had the answers with the steps worked out.

Dan: I liked the one with the steps worked out for the integers.

Interviewer: So that's the one you found the homework easiest to do?

Dan: Yep.

Interviewer: Why did you find that homework the easiest to do?

Dan: ...Well it showed me how to do the questions correctly.

Interviewer: Did you find that topic easy as well?

Dan: Ahhh..(unintelligible)

Interviewer: Adding and subtracting integers...

Dan: Yeah.

Interviewer: ..Ok, actually,, did you find adding and subtracting easier than multiplying and dividing?

Dan: Sort of...but I think they were both kinda easy (ha).

Interviewer: ... In which of those three units was the homework the most useful in helping you learn the material?

Dan: 'K there was adding and subtracting, ah..

Interviewer: Multiplying and dividing, and then the algebra.

Dan: I think it was pretty good in the algebra.

Interviewer: Why did the homework help you the most in algebra?

Dan: ... 'Cause the same reason as always,... like it showed me how to do it.

Interviewer: Ok, you just had answers only for algebra.

Dan: Well, I knew the procedure, I just got the answers of a that and corrected it.

Interviewer: Ok,..So,, did you use the supplied answer keys when you did your homework?

Dan: Yep.

Interviewer: Did you use them on a regular basis?

Dan: Aahh..Sometimes I didn't when I knew exactly what I was doing.

Interviewer: How did you know you knew what you were doing?

Dan: Well,..I checked it a couple of times and eventually I knew what I was doing.

Interviewer: ... So you, by using the answer key then you developed the confidence to know..

Dan: Yeah.

Interviewer: Did you..did you use the answer keys as you were doing your homework, or did you wait until you were finished before you checked the answer key?

Dan: As I was working.

Interviewer: Did you find that a good way to do it?

Dan: Yeah

Interviewer: ...Did having an answer key affect how much you learned from the homework?

Dan: ... Aahh..yeah, I guess so,...

Interviewer: How?

Dan: I learnt more.

Interviewer: ..That's a keen answer..Which type of answer key helped you the most?

Dan: The work.

Interviewer: ..Why?

Dan: ...Uh..it gave me the answer and showed me the steps how to do the question (unintelligible) give me the idea how to do the next question after that, and so on.

Interviewer: ...That's kind of a neat comment, I like that one. .. Did, has used, has, has using an answer key changed the way you do math?

Dan: Yeah, in some ways.

Interviewer: Can you describe those ways at all?

Dan: Um..Well just kinda the way I thought towards, like, questions, its kinda like ah,...instead of like using a a number chart I'd like add instead like I used to use like a one-two-three chart in my head but now I use an adding-subtracting kinda thing... a number line sorta..

Interviewer: Did you use the worked out answer keys to figure out how to structure

your work on the page to make it look more organized?

Dan: Yeah.

Interviewer: So that was useful ?

Dan: Umhum

Interviewer: Um...Do you do it that way on your own now?

Dan: ... Most of the time.

Interviewer: ..Alright...Did you have any comments to say about the answer keys this year?

Dan: I liked it.

Interviewer: So you're looking forward to seeing them again next year maybe?

Dan: Yep.

Interviewer: Good. Thanks very much Dan, we're all done.

Jake

Interviewer: Good morning Jake, this is your last interview with me,..and you've now completed units of study in Math 8 that have required you to do homework. During this time you've had one unit without an answer key, that was doing integers, multiplying and dividing and all operations, order of operations, one unit with an answer key consisting of the answers only, that would be algebra and you had one unit with the answer keys that had the question all worked out as well as the answer. That was adding and subtracting integers. I'm going to ask you the same questions that you've had before to get your opinion on the three types of homework support that you got. Number one, in which unit of study did you find the homework easiest to do?

Jake: Um,..The adding and subtracting integers.

Interviewer: Why is that?

Jake: 'Cause the steps were just simple,..the steps were simple.

Interviewer: Alright,..Did um, having an answer key play a role in your choice of which of that homework being the easiest to do?

Jake: Ahhh,..a small part yeah. It was basically easy, I mean I got most of the answers right but any ones I had a bit of trouble on I went to the answer key to figure out what I did wrong.

Interviewer: ..I which of those three units of study did you find the homework most useful in helping you learn the material?

Jake: ...Ahhh, Is that by answer key or..

Interviewer: In total. The algebra, the first integers, or the second integers. Which one was the homework easier, urgh, which one did the homework, which one for you, which one was the homework most useful?

Jake: Probably the algebra.

Interviewer: ..And why is that?

Jake: ‘Cause it included all the units that we already did.

Interviewer: ... What do you mean?

Jake: um,..Well, I think it was the hardest out of the three of them, but it had a lot of steps that you had to do math a lot,..like ah adding and subtracting, times, dividing.

Interviewer: ..Alright, so did having an answer key um, .. play any role in the algebra being the most useful?

Jake: ..ahh, Which answer key, which..

Interviewer: The answers only.

Jake: The answers only,..well, I wish that the algebra had the steps with it ‘cause some that I got wrong I couldn’t fix it ‘cause I couldn’t find where I got it wrong. like the answers were wrong and I took the answer key and I checked what the answer was and I couldn’t find how you, how I got it.

Interviewer: Well explained...Did you use the supplied answer keys when you did your homework?

Jake: Pardon me?

Interviewer: Did you use those answer keys when..you..did..the homework?

Jake: Yeah.

Interviewer: Did you use it, did you check your answers while you were doing your homework or after you were finished?

Jake: After I was finished.

Interviewer: ..What happened when you'd come upon a question you got wrong, what would you do?

Jake: Well, I'd go over the steps again, like, ..ah, and if I still had trouble with it I'd go back in the book and ah, to where the section was where they taught us how to do it..

Interviewer: Did you, so you re-did your work then if you had the wrong answer.

Jake: Yes.

Interviewer: Alright, did you, did you, why did you wait until you had finished your homework before you checked your answers?

Jake: um... Just so I couldn't peek at it and just put the answers down.

Interviewer: ..Honest answer...Did having an answer key affect how you learn, or did it affect your learning from the homework?

Jake: Yes.

Interviewer: How?

Jake: 'Cause with the answer key, with, with the steps worked out it helped me ah, figure out what I did wrong,..and ah, just helped me.

Interviewer: Did you find, did you, having an answer key with all the steps worked out change the way you do math?

Jake: uuhhh...I don't think so, it just pointed out the steps I did wrong.

Interviewer: Did you use it as a model for how to write out your math when you were doing homework at all?

Jake: Yes.

Interviewer: That's it. we're all done. Thanks very much...

Jake: Alright.

Interviewer: ...For participating. Any comments on the answer keys that you wanted to give me?

Jake: No, just have 'em in 9A. [9A is the non-academic math course at the grade 9 level]

Daphne

Interviewer: Well Daphne, thanks for participating in my study this year, this is your last interview. You've now completed units of study in Math 8 that have required you to do homework. You've during this time had one unit without an answer key, that was doing integers, multiplying and dividing and order of operations, you had a unit with an answer key consisting of the answers only, that was the algebra – the last one we did, and then you had a unit with the questions worked out, and that was adding and subtracting integers. You're going to get the same questions you've had before, ahhh the first question being in which unit of study did you find the homework easiest to do?

Daphne: ..um, Order of operations.

Interviewer: Why is that?

Daphne: I just find them easy to do.

Interviewer: That's a good answer, actually, its good that you find order of operations easy to do. Ah, in which of those three units of study did you find the homework most useful in helping you learn the material?

Daphne: Algebra.

Interviewer: Why would that be?

Daphne: 'Cause you have to work all that stuff out... And then you can, like, think of stuff when you're doing it.

Interviewer: ...Ok, Did you do, um,..Did you use the supplied answer keys when you did your homework?

Daphne: ...ah, After I did the homework.

Interviewer: ...So you do your homework, get it all finished, then check your answers.

Daphne: Yes.

Interviewer: What happened when, if you were checking your answers and you saw you got one wrong. What did you do then?

Daphne: Just do it all over – work it out ‘til it’s correct.

Interviewer: Did you find that, useful?

Daphne: Umhum.

Interviewer: ...And how come?

Daphne: What, the answer key thing? Well, because ... when you get one wrong then you can just figure out where you went wrong and then you go back to school and you can get it all right and all that stuff.

Interviewer: That’s always nice isn’t it.

Daphne: Yeah.

Interviewer: ...Did having an answer key affect your learning from the homework?

Daphne: ...No... not really.

Interviewer: ...Why not?

Daphne: ...Because... You’re not really ... using anything, like, when you have the ones just the answers ... with the answer keys, ... you’re just, looking at the answers and not all the written ones out. But I think when you use the ones with all the writing on it I think you’re cheating in a way. ‘Cause then you don’t know all the steps and stuff. I feel that you can just use it with the answer key, like just the answer, I don’t know why.

Interviewer: That’s a good comment actually, I like that comment a lot. .. Did you, did you find having the worked out answers in front of you did you model your work the same as that? Doing all those steps?

Daphne: Yeah... in a way.

Interviewer: ...Would that did that be a benefit?

Daphne: Yeah.

Interviewer: ... And you've already answered this question, but I'm going to ask it anyway. Of the two types of answer keys we used, which type did you find the most useful?

Daphne: Just the ones with the answers only.

Interviewer: You've told me why already so I won't ask you that one again. ... Did using an answer key change the way you do math?

Daphne: ...No.

Interviewer: ... Did you use the worked out examples to guide your homework at any time?

Daphne: ...I didn't really use the answer key when I used, had just the worked out answers, I (unintelligible) I don't like using that ..

Interviewer: ...Because you felt like you were cheating..

Daphne: Yeah.

Interviewer: Alright, that's a really neat thought. do you have comments you want to make to me? Or of the answer keys?

Daphne: ... Not really.

Interviewer: Ok. Thanks a lot Daphne, you can go back and finish your work now.

Sue

Interviewer: Hi Sue how 'ya doing?

Sue: Pretty good.

Interviewer: This is your last interview, it's what, June 12th. You've now completed units of study in Math 8 that have required you to do homework. You've during this time had one unit without an answer key, One unit with an answer key consisting of the answers only, and one unit with the answer keys consisting of the questions worked out showing the proper steps involved in reaching the answer, as well as the answer. So you had algebra, actually for integers, adding and subtracting you had the answers worked out, for integers, multiplying and dividing and order of operations you didn't have an answer key, and then algebra – the last unit you did, that was the

answers only. So in which unit of study, of those three units, did you find the homework easiest to do?

Sue: Um..ah,..the one with the answer s worked out.

Interviewer: Which one was that?

Sue: Adding and subtracting integers (unintelligible)..

Interviewer: Why is that?

Sue: 'Cause it showed you how to get the answer. And dealing with steps and stuff.

Interviewer: Did you use the, that answer key to guide you to the right answers a lot in that unit?

Sue: ...Most of the time.

Interviewer: ...Which of those three units did you find the homework most useful in helping you learn the material?

Sue: uh,..The (unintelligible) one.

Interviewer: That was the adding and subtracting integers?

Sue: Yeah.

Interviewer: Why is that?

Sue: ...I don't know,..(unintelligible).

Interviewer: You sure?

Sue: Yeah.

Interviewer: When you did your homework, did you use the answer keys?

Sue: Yeah.

Interviewer: Did you..

Sue: Sometimes,..

Interviewer: That's honest. Did you, when you say sometimes, about how much, how much of the time – half the time, a quarter of the time,...

Sue: When I didn't forget to bring it home.

Interviewer: That's alright... I like that answer a lot. I'm going to use that one... ah... when you were using the answer key, did you check as you were doing the homework, or did you wait until you were finished?

Sue: After I finished it, and then I checked it.

Interviewer: If you find you had a question, what did you do at that point?

Sue: I erased it and then I followed the steps that was in the answer key.

Interviewer: ...Why did you wait 'til you were finished before you checked your answers?

Sue: To see if I was doing it right.

Interviewer: ...Is there a reason why... you..made a choice to not check as you did your homework..why did you choose not to do that?

Sue: I don't know, I just usually do my work first and then check it.

Interviewer: Fair enough. Did having an answer key .. change or did having it, did using an answer key affect your learning from the homework?

Sue: It made it easier..to follow 'cause of all those steps were all worked out for you so all you had to do was follow them.

Interviewer:... That's a neat answer, that's really good. which type of answer key did you like, did you find the most useful – the answers only or the worked out answers?

Sue: The worked out ones.

Interviewer: And why was that?

Sue: They had the steps .. that you followed .. and then it was easier to get the answer.

Interviewer: Did using, has using answer keys changed the way you do math?

Sue: ... Yeah, because I remember like the steps again and stuff.

Interviewer: That's a neat answer. Will you in the future continue to use answer keys?

Sue: If they have them.

Interviewer: If they have them, I believe they do for everything else from now on. ... And you've already answered the next question, but I'll ask it anyway. did you use the worked out examples to guide your home, to guide you in how you did your homework?

Sue: Yep.

Interviewer: Ok. Any other comments to make?

Sue: Nope.

Interviewer: Alright. Thanks very much.