Scaffolding as a Method of Teaching Mathematics in Middle School

An Interactive Qualifying Project

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Abstract

This IQP proposes scaffolding as a teaching strategy to enhance mathematics learning in the classrooms. This experiment proves that scaffolding method of teaching alongside with many others could be used successfully at school to enhance students' performance in mathematics as well as in other subjects.

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Chapter 1

Introduction

Today's schools must accommodate students from different ethnic groups, language groups, cultures, family situations, and social and economic situations, with different interests and purposes for learning, and different abilities and styles of learning. In the face of all this diversity, schools can no longer operate as if one curriculum and way of teaching will fit most of the students. Instead, students can pursue a common set of curricula goals or learning standards, accomplishing them in different ways and sometimes to different degrees of mastery.

"No Child Left Behind" puts special emphasis on determining what educational programs and practices were especially effective through accurate scientific research. Federal funding is targeted to support these programs and teaching methods that work to improve student learning and achievement.

America's schools are not producing the math excellence required for global economic leadership and homeland security in the 21st century. That is why it is very important to use scientifically based methods with long-term records of success to teach math and measure student progress. It is also important to establish partnerships with universities to ensure that knowledgeable teachers deliver the best instruction in their area.

Math is a critical skill in the information age. On one hand, technology advances with great speed, but on the other hand, stagnant math performance in schools hinders our students' future and endangers prosperity and nation's security. Math achievement is improving slightly, but much more work must be done to ensure that our children receive a sound background in mathematics.

This project analyzes the results of the students' performance which were received in the process of the experiment. The experiment involved two different teaching strategies, namely, hint-based strategy and scaffolding questions. One of the goals of the experiment was to see which method is more effective in teaching mathematics at middle school so as in future recommend the most successful one to the teachers. After very extensive analysis I came to the conclusion that scaffolding helped students to learn the subject (in this case mathematics) better. In this paper the data and the results of the experiment will be given.

Chapter 2

Background

Many teachers have different views on what mathematics is, how students learn mathematics, and how mathematics should be taught. Vygodsky's views on learning [VYG78] were that he felt students should not be considered as passive recipients of mathematical knowledge, but that education should give the students opportunities to be able to reinvent mathematics by doing it themselves. Educators have been talking much about constructivism as the learning theory for mathematics education since the last quarter of the last century.

This paper proposes scaffolding as a teaching strategy to enhance mathematics learning in the classrooms. Scaffolding is formulated from Vygotsky's concept of the zone of proximal development. It emphasizes active participation or a greater degree of control from students over their learning [VYG78].

When scaffolding is directed to the needs of a student tackling a meaningful and challenging task, the student will be able to accomplish the task, which is otherwise difficult. However, teachers need to change their role in the classroom from the sole source of mathematical knowledge to facilitators in the development of students' mathematical constructions, while employing scaffolding. The common interactions in scaffolding are focusing on a gap to bridge in students' knowledge to accomplish a task, extending by raising the skill level: asking questions like "What else will you do?", refocusing by encouraging clarification and justification by asking questions like "Is this what you are trying to say?"

The role of the teacher is extremely important at the lessons (in this case the role of the teacher was performed by the system). It is to help students make connections and synthesize what they have already learned. True learning occurs when information is integrated into an individual's knowledge. According to Bickmore-Brand, scaffolding is defined as the process by which an expert provides temporary support to learners to "help bridge the gap between what the learner knows and can do and what he or she needs to accomplish in order to succeed at a particular learning task" [BIK90]. Upon completion of this task, a student can better make the connection between prior knowledge and new information. Scaffolding helps this happen by allowing the teacher to interact with the student by asking leading questions and providing information in order to help students discover the information they need to successfully complete a task. However, part of the function of a scaffold is to "self-destruct"—the student gains enough mastery to the point that he or she no longer needs scaffolding and it is no longer provided. Scaffolding keeps students on task.

In Bickmore-Brand's analysis of scaffold styles in teaching mathematics, three scaffolding styles emerged: task focused, child focused, and multi-focused. The task focused style is more concerned with the requirements of the task whereas the child focused style allows the teacher to explore a task based on how the student chooses to explore it. In the former style the teacher asks a minimum number of formal questions. In the latter style the teacher asks a lot of general questions. With each of these styles also comes a specific way in which the teacher provides responses to the student.

Task focused answers are "brief, unexpanded" and serve the purpose of letting the student know whether or not he or she is answering the questions correctly. Student focused responses to questions are "supportive, positive" and totally reflective of the student's zone of proximal development. The multi-focused style is a bit less reflective of a particular child's zone of proximal development. The teacher is just as concerned with task-oriented questions as he or she is with the student's mastery of the task. Anyway this balance seems to be the most effective approach because the teacher's ability to address the student's needs makes it easier for the student to address the task's requirements [BIK90]. Task focused style of scaffolding was mainly used in our experiment because our system didn't allow to check the responses of the students. Though we used task oriented style of scaffolding, we still tried to show different ways of solving the problems which helped the students to practice various types of thinking.

Chapter 3

Metrics and Scenarios

The experiment data was collected using the Intelligent Tutoring System project, which was built by a large group of students under the leadership of Professor in Computer Science Neil Heffernan. The main purpose of this project is to deliver intelligent tutoring for the eighth grade MCAS. This was mainly done by taking some of the MCAS problems from the previous years and delivering them in such a way that students could understand and solve them without any difficulties. In addition to that, students could also learn the main concepts and strategies used for doing different exercises which could help them to get the right answer to similar problems (on the same topic).

All the problems were grouped in different curricula. We tried to organize the problems in such a way that all the problems on the same topic or all the problems that had the same solution strategy were grouped in the same curriculum. It is a really good idea that not only helps a student to figure out a way how to solve a single problem, but also helps to learn the main concept that can be reused many times in other similar situations. Usually if somebody is dealing with the new material or difficult problem, it is very hard to find the correct solution and it will be even much harder to remember it, but solving the same type of problems over and over, practicing the same type of material for some time helps to remember it for longer time. Since many of the problems are very similar in each curriculum, it will give a sufficient amount of practice to review the knowledge received. On the other hand, it is very good for researchers too. It helps them to construct different experiments on many curricula that can analyze students' performance and summarize their learning styles. This information could be taken in consideration for the future development of the curricula.

We ran a number of experiments on different curricula to find out the best way of teaching the students to maximize the learning. One of the curricula we used for this experiment included eleven probability items. These eleven problems used two different ways to tutor the students how to solve them. The first way was braking down the problem using just hints. When a student was given the problem with hints, he was given the original problem first. He also was asked for an answer. Some of the problems had multiple choices, but some of them required direct input from the user. If the student gives the right answer to the original question, then he or she can proceed to the next question. Otherwise, the student can ask for a hint. Many of the questions had multiple hints, and usually the last hint almost gave the right answer. It was students' responsibility to ask for each additional hint and try their best to solve the problem using as few hints as possible. One of the problems from this curriculum with the hints learning strategy is displayed in Figure 1.1.

The second way to break down the problem was using scaffolding questions. When a student was given the problem with scaffolding questions, he got the original problem first. If the student answered correctly to the original question, then he or she could proceed to the next one from the same curriculum. But if the student answered wrong to the original question, he or she was automatically taken to the next step. Before that, the original question was disassembled into multiple scaffolding questions, each with hints to help the student solve the original problem in smaller and easier steps. The question was still counted as wrong one, but the student had more knowledge and skills to be able to go through the rest of the curriculum with similar problems. The snapshot of one of the examples is given in Figure 2.1.

Every curriculum was randomly assigned to each student when they logged into the system, so about 50 percent of the students in each class solved the problems with hints and 50 percent solved the problems using scaffolding questions. In addition to these eleven problems, students were asked to do a set of other 11 problems which were very similar to the first set. This was done to analyze the amount of knowledge received by each student by the end of the curriculum. This is actually a good measure which can also tell us which of the tutoring methods worked the best. If the students who completed the first set of questions with hints did better on the second set of questions in comparison to the students who worked on questions with scaffolding, then it showed that the strategy of giving hints delivered more knowledge to the students than the strategy of asking scaffolding questions. This part of the curriculum could be a key to the final verdict.
The next chapter displays the data received as a result of this experiment and gives the explanation for each analysis; also it comes to an end with a final conclusion.

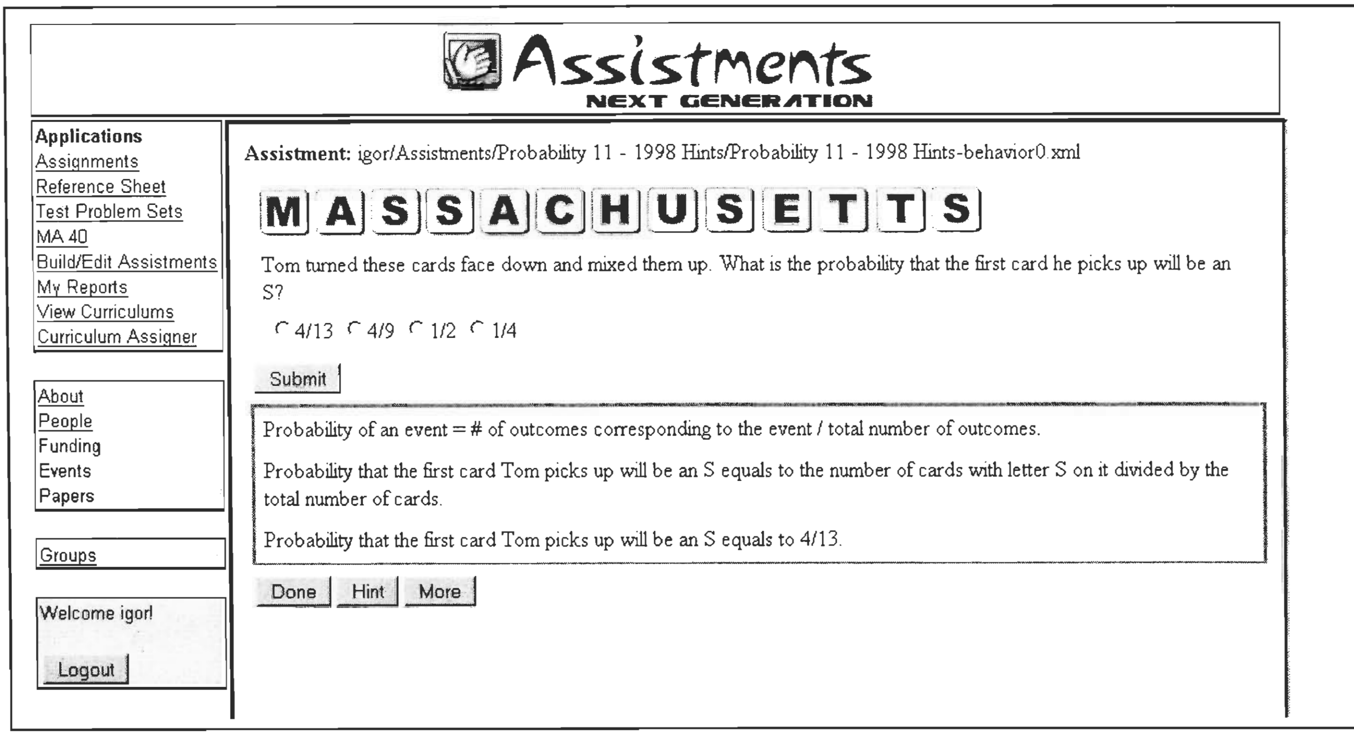


Figure 1.1: The snapshot of the problem with a hints tutoring technique.

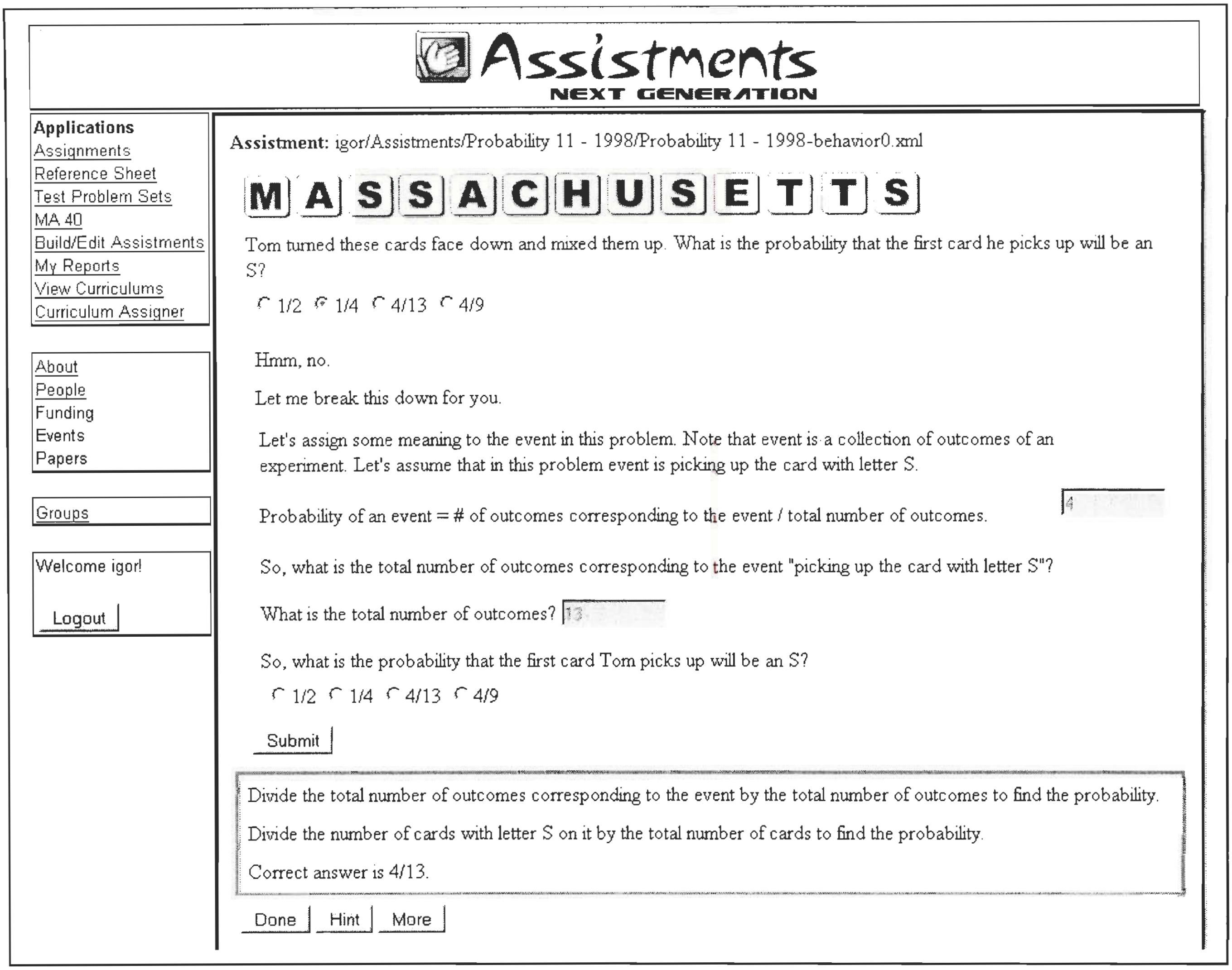


Figure 2.1: The snapshot of the problem with a scaffolding questioning technique.

Chapter 4

Results

4.1 Factors affected final results

The previous chapter provided a brief scenario of the experiment. Even though we tried to make the experiment as fair as possible, such as randomizing the selection process between two states and randomizing students (different classes and schools on different days of the week), we still had some factors that had a minor effect on our results. Some of these issues are further described in this part of the chapter.

One of the major factors which should be taken into account is that all people are different. Some of the students are more creative than others; some of them have more knowledge and better background in different areas of math and science than others. For example, in our classroom there were students who had pretty good knowledge in probability area.

There is also a difference between students in logical mode of thinking. Some students are more capable in mathematics, some in humanities. We tried to eliminate that issue as much as possible by assigning different methods absolutely randomly to each student in the class. The large number of students gave us a chance to be as accurate as possible. In addition to that, we used different periods and even different schools in order to get most diverse results.

We tried to eliminate other issues too in order to end up with the best results possible. One of the other issues that really surprised me was a problem of "gaming" among some students. Some students did not want to pay much attention to the problems in comparison to other students. Because almost all of them were not going to get any grade for it, the "Assistments" system became another chance for them to have some fun. We tried to eliminate this question by analyzing the log file which stored every action for every student and tried to find and get rid of the "infected" data. For example, if the student did not finish the problem for the reasons of gaming, then the data was not included in the final result. More information on the analyses of the log file is given in the Appendix A. Although it is almost impossible to absolutely remove the factor of gaming, we had a great success in making it as minimum as possible. This issue is taken very seriously by the development team and it is planned to eliminate it in the nearest future.

We can also assume that there is another factor which could influence the time measure. It is difference in students' computer skills. The group of students, who had been working with this program for longer period of time than another group, managed to get more computer skills and manipulated with the program much faster. This could be one of the factors which affected the problem solving time, and prevented from accidental mistakes.

4.2 Performance measure

A two way analysis of variance (ANOVA) is used to test whether two different factors affect a particular variable. This test is also used to determine if there is an interaction between the two variables. An interaction can be defined as whether two factors act together to produce a greater or lesser effect than what we would expect from the effects individually. Let's assume that the student performance will depend on two factors: condition (problem with scaffolding or problem with hints) and the problem itself. In order to receive the results, we ran an analysis of variance (ANOVA) on the set of data collected. The basic question that ANOVA tries to answer is whether there is a difference of the population means of the different groups.

The main result of this part of the experiment was student's performance. The ANOVA table (Figure 3.1) contains the degrees of freedom (or sample size minus 1), F-value, and P-value. There are three P-values. The first one tells us whether student performance depends on one of the conditions (hints or scaffolding). In this case, since the P-value is less than 0.05, we conclude that our two groups of questions do not give the same results. The second P-value tells us whether the problem has any influence on the results. In our case, *at least one* problem item class controls the results. The third P-value tells us if there is a significant interaction between year and condition, and there is not. Let's continue with our analysis and take a look at other tables.

The second table (Figure 3.1) illustrates some general information for each problem, such as the number of students who finished each problem, mean value for the number of correct answers, standard deviation, and standard error. Note that this table contains the results for both groups of the questions. Right from the table, it is very easy to see that the mean is much higher for the majority of problems with scaffolding question in comparison to problems with hints. The standard deviation shows the measure of variability for each problem. It is not very large in both cases which tells us that the results are very close to an average. The standard error is a measure of the size of the variation in the sample statistic over all samples of the same size as the study sample. Small standard error tells us that the variation across samples is small, and since we have large sample size, it makes sense. The bar chart makes it easier to visualize the average number of correct answers. Keep in mind that two similar problems are colored in different colors, but ones with hints are located on the left side, and ones with scaffolding are located on the right side. For nine out of eleven problems, the average number of the right responses for the scaffolding questions is a little larger that for the hints. On the contrary, only two problems gave better results for the hints compared to the scaffolding questions.

In addition to this information, Figure 3.2 illustrates more pair wise contrasts for each of the problems (Fisher's PLSD). So for each pair, the table displays the mean difference, the corresponding critical values, and the p-value. Fisher's PLSD is the most liberal test and risks a higher probability for an error in the multiple comparisons.

In our case we can see that the condition influences student performance. The number of correct answers does depend on the question itself (the difficulty of the problems may vary) but it also depends on the condition (questions with hints or questions with scaffolding). Analysis shows that students do much better on the questions with the help of scaffolding. In addition to the Two-Way ANOVA, One-Way ANOVA was performed based just on the condition. It reinforces our conclusion. The Figure 3.3 displays the total average of the means both for hints and scaffolding. Even though the number of students who solved the problems with the help of scaffolding questions is a little fewer comparing to the number of students who solved the problems using hints, the average mean for the number of the correct answers is thirty percent larger.

4.3 Time measure

In the previous section we came to the conclusion that the students, who were solving problems with the help of scaffolding questions, got more correct answers than those students who solved problems with the help of hints. Now let's analyze the average time which the students spent to complete each problem. This is another good factor which can tell us a lot about students' performance. During the experiment, all the actions performed by the students were stored in the database. This allowed us to get the amount of time the students spent on the original problem and on all problems in general. We tried to use this information in our analysis. Figures 4.1 and 4.2 show the results we got. Since $P>0.05$, we can conclude that there is no difference in time for both conditions. On the other hand, we can see from the table of means that the average time for each question with the help of scaffolding is less that the average time for the question with the help of hints. It is still a strong argument in favor of scaffolding. From both analyses, we can see that scaffolding questions really help students to learn the material in more efficient way. This result can be really helpful in the future development of the system and can make a big difference in teaching.

4.4 Post Experiment Analysis

In Chapter 3, I mentioned some additional problems which were included in each curriculum right after the main set of problems. The purpose of the second set of problems was to figure out if the learning process occurred after running the first set with two different conditions (hints and scaffolding). One-Way ANOVA was performed on the second set of problems. But we took into account the condition of the first set (hints or scaffolding). The final results showed that those students, who previously completed the section with scaffolding, performed much better with the second set of problems. It reinforced our conclusion about the advantages of scaffolding. Final results are displayed in Figure 5.1.

ANOVA Table for Result

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Item	10	37.788	3.779	21.068	<.0001	210.681	1.000
Condition	1	5.273	5.273	29.400	<.0001	29.400	1.000
Item * Condition	10	1.165	.117	.650	.7714	6.496	.343
Residual	767	137.570	.179				

Means Table for Result
Effect: Item * Condition

	Count	Mean	Std. Dev.	Std. Err.
11yr1998, Hints	42	.905	.297	.046
11yr1998, Scaffolding	30	1.000	0.000	0.000
15yr1999, Hints	42	.667	.477	.074
15yr1999, Scaffolding	30	.800	.407	.074
15yr2002, Hints	42	.619	.492	.076
15yr2002, Scaffolding	30	.767	.430	.079
16yr2000, Hints	42	.762	.431	.067
16yr2000, Scaffolding	30	.900	.305	.056
18yr1999, Hints	42	.643	.485	.075
18yr1999, Scaffolding	31	.806	.402	.072
20yr1999, Hints	42	.595	.497	.077
20yr1999, Scaffolding	30	.833	.379	.069
25yr1999, Hints	42	.571	.501	.077
25yr1999, Scaffolding	30	.933	.254	.046
28yr2001, Hints	41	.171	.381	.059
28yr2001, Scaffolding	29	.241	.435	.081
33yr2001, Hints	42	.714	.457	.071
33yr2001, Scaffolding	30	.900	.305	.056
37yr2002, Hints	42	.214	.415	.064
37yr2002, Scaffolding	29	.414	.501	.093
8yr2002, Hints	42	.357	.485	.075
8yr2002, Scaffolding	29	.448	.506	.094

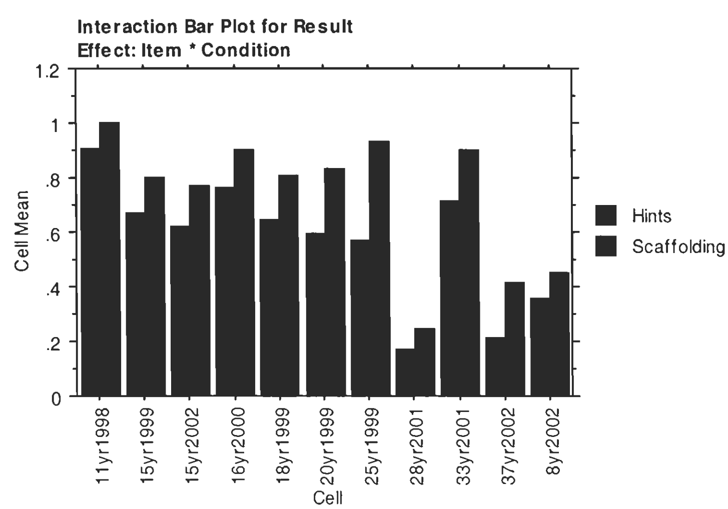


Figure 3.1: This Figure gives the ANOVA table for the performance based on two factors: condition (hints versus scaffolding) and problem item itself. It also provides the means table for each problem, and the bar plot for result.

Fisher's PLSD for Result
Effect: Item
Significance Level: 5 %

	Mean Diff.	Crit. Diff.	P-Value	
11yr1998, 15yr1999	.222	.139	.0017	S
11yr1998, 15yr2002	.264	.139	.0002	S
11yr1998, 16yr2000	.125	.139	.0770	
11yr1998, 18yr1999	.232	.138	.0010	S
11yr1998, 20yr1999	.250	.139	.0004	S
11yr1998, 25yr1999	.222	.139	.0017	S
11yr1998, 28yr2001	.744	.140	<.0001	S
11yr1998, 33yr2001	.153	.139	.0307	S
11yr1998, 37yr2002	.649	.139	<.0001	S
11yr1998, 8yr2002	.550	.139	<.0001	S
15yr1999, 15yr2002	.042	.139	.5552	
15yr1999, 16yr2000	-.097	.139	.1688	
15yr1999, 18yr1999	.010	.138	.8882	
15yr1999, 20yr1999	.028	.139	.6940	
15yr1999, 25yr1999	0.000	.139	•	
15yr1999, 28yr2001	.522	.140	<.0001	S
15yr1999, 33yr2001	-.069	.139	.3255	
15yr1999, 37yr2002	.426	.139	<.0001	S
15yr1999, 8yr2002	.328	.139	<.0001	S
15yr2002, 16yr2000	-.139	.139	.0495	S
15yr2002, 18yr1999	-.032	.138	.6516	
15yr2002, 20yr1999	-.014	.139	.8441	
15yr2002, 25yr1999	-.042	.139	.5552	
15yr2002, 28yr2001	.481	.140	<.0001	S
15yr2002, 33yr2001	-.111	.139	.1159	
15yr2002, 37yr2002	.385	.139	<.0001	S
15yr2002, 8yr2002	.286	.139	<.0001	S
16yr2000, 18yr1999	.107	.138	.1282	
16yr2000, 20yr1999	.125	.139	.0770	
16yr2000, 25yr1999	.097	.139	.1688	
16yr2000, 28yr2001	.619	.140	<.0001	S
16yr2000, 33yr2001	.028	.139	.6940	
16yr2000, 37yr2002	.524	.139	<.0001	S
16yr2000, 8yr2002	.425	.139	<.0001	S
18yr1999, 20yr1999	.018	.138	.7994	
18yr1999, 25yr1999	-.010	.138	.8882	
18yr1999, 28yr2001	.512	.139	<.0001	S
18yr1999, 33yr2001	-.079	.138	.2597	
18yr1999, 37yr2002	.417	.139	<.0001	S
18yr1999, 8yr2002	.318	.139	<.0001	S
20yr1999, 25yr1999	-.028	.139	.6940	
20yr1999, 28yr2001	.494	.140	<.0001	S
20yr1999, 33yr2001	-.097	.139	.1688	
20yr1999, 37yr2002	.399	.139	<.0001	S
20yr1999, 8yr2002	.300	.139	<.0001	S
25yr1999, 28yr2001	.522	.140	<.0001	S
25yr1999, 33yr2001	-.069	.139	.3255	
25yr1999, 37yr2002	.426	.139	<.0001	S
25yr1999, 8yr2002	.328	.139	<.0001	S
28yr2001, 33yr2001	-.592	.140	<.0001	S
28yr2001, 37yr2002	-.096	.140	.1798	
28yr2001, 8yr2002	-.194	.140	.0066	S
33yr2001, 37yr2002	.496	.139	<.0001	S
33yr2001, 8yr2002	.397	.139	<.0001	S
37yr2002, 8yr2002	-.099	.140	.1658	

Figure 3.2: The Fisher's PLSD for the result (pairwise comparison of the results for each problem question).

ANOVA Table for Result

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Condition	1	.391	.391	6.602	.0110	6.602	.730
Residual	173	10.238	.059				

Means Table for Result
Effect: Condition

	Count	Mean	Std. Dev.	Std. Err.
Hints	94	.527	.216	.022
Scaffolding	81	.622	.272	.030

Interaction Bar Plot for Result
Effect: Condition

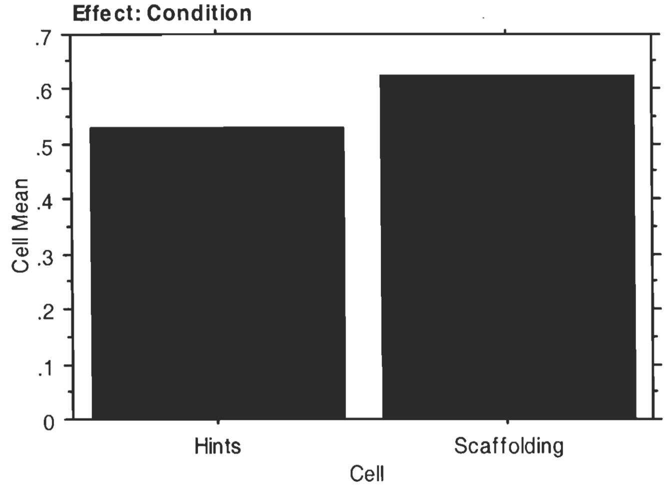


Figure 3.3: One-Way ANOVA performance analysis based on the condition (hints versus scaffolding).

ANOVA Table for Question Time(sec)

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Condition	1	4126.070	4126.070	3.056	.0812	3.056	.397
Item	10	48825.362	4882.536	3.616	.0001	36.163	.997
Condition * Item	10	14101.801	1410.180	1.044	.4048	10.445	.550
Residual	430	580563.367	1350.147				

Means Table for Question Time(sec)
Effect: Condition * Item

	Count	Mean	Std. Dev.	Std. Err.
Hints, yr1998-11	26	19.115	24.549	4.815
Hints, yr1999-15	27	14.556	23.016	4.429
Hints, yr1999-18	26	60.077	57.097	11.198
Hints, yr1999-20	19	47.368	37.836	8.680
Hints, yr1999-25	27	28.074	28.202	5.428
Hints, yr2000-16	27	27.593	34.341	6.609
Hints, yr2001-28	27	32.593	32.058	6.170
Hints, yr2001-33	26	20.577	26.268	5.152
Hints, yr2002-15	27	21.111	30.911	5.949
Hints, yr2002-37	27	50.148	49.843	9.592
Hints, yr2002-8	27	34.778	36.080	6.944
Scaffolding, yr1998-11	14	17.929	24.597	6.574
Scaffolding, yr1999-15	15	15.600	23.730	6.127
Scaffolding, yr1999-18	15	36.067	38.313	9.893
Scaffolding, yr1999-20	15	27.667	36.217	9.351
Scaffolding, yr1999-25	15	22.267	27.927	7.211
Scaffolding, yr2000-16	15	13.267	21.875	5.648
Scaffolding, yr2001-28	16	48.063	76.308	19.077
Scaffolding, yr2001-33	15	13.067	26.847	6.932
Scaffolding, yr2002-15	15	29.400	27.772	7.171
Scaffolding, yr2002-37	15	32.133	42.589	10.996
Scaffolding, yr2002-8	16	31.438	36.471	9.118

Interaction Bar Plot for Question Time(sec)
Effect: Condition * Item

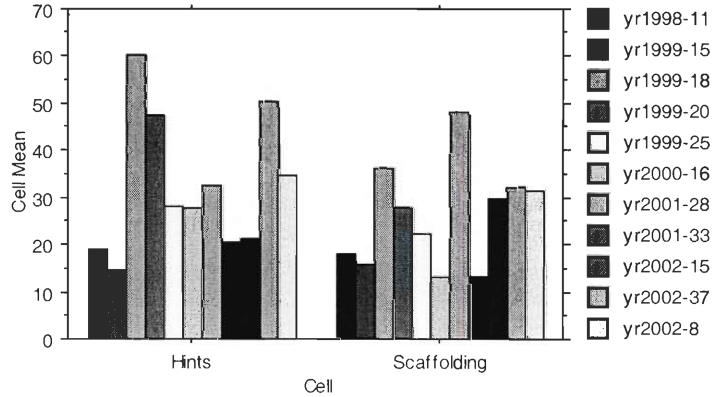


Figure 4.1: This Figure gives the ANOVA table for the time based on two factors: condition (hints versus scaffolding) and problem item itself. It also provides the means table for each problem, and the bar plot for result.

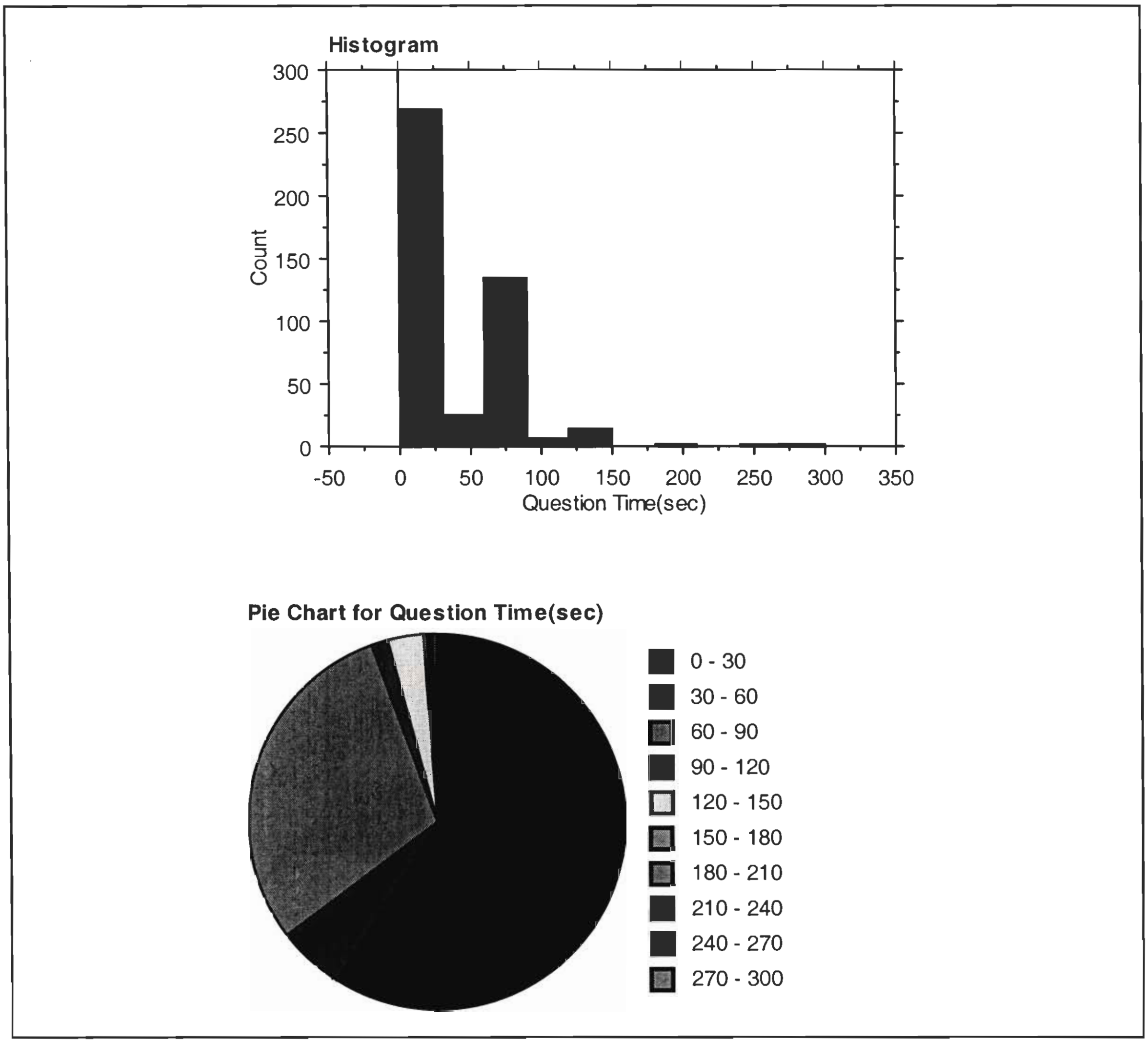


Figure 4.2: The histogram and the pie chart for the average solution time.

ANOVA Table for Result

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Pow er
Condition	1	.383	.383	7.588	.0075	7.588	.786
Residual	71	3.582	.050				

Means Table for Result
Effect: Condition

	Count	Mean	Std. Dev.	Std. Err.
Hints	42	.566	.226	.035
Scaffolding	31	.712	.223	.040

Interaction Bar Plot for Result
Effect: Condition

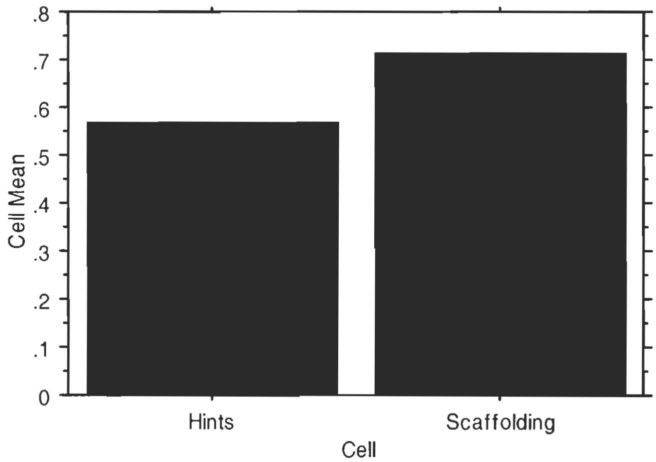


Figure 5.1: Post-experiment performance analysis (analyses of transfer items).

Chapter 5

Conclusion

This research illustrates that scaffolding is a teaching strategy that can enhance mathematics learning and help implement constructivism in the classrooms. There is no doubt that our experimental group has received many positive results while using the strategy of scaffolding questions in the middle school mathematics class. This method provided an effective way for students to gradually but thoroughly learn a math concept using their background knowledge. Though there were some issues which could have some effect on the final results such as different students' background, different computer skills etc., students still became more confident and more successful during independent practice because they better understood the math concept due to the scaffolding process.

This experiment proved that scaffolding method of teaching alongside with many others could be used successfully at school to enhance students' performance in mathematics as well as in other subjects. This method has given and will give a good background in mathematics for future generations of students. At the same time this project can stimulate many educators and researchers to work on new and more productive teaching strategies which would give students good education. In fact, the experiment will influence our future research work. We will use the results in the development of more effective teaching curriculum.

Appendix A

Data Examples and Scripts

The original log file contains an entry for each action performed by every student. The log file has a specific structure, which includes an entry for each curriculum started, followed by the PROBLEM_START entry then comes a list of actions, and the last row is the PROBLEM_DONE entry. Since it contains every single action, the file can be very large in size. The snapshot of some of the columns is shown in the next table.

ACTION_	ACTION_	SCHOOL	TUTOR_	CLASS	USER_	ACTION	ACTION_TYPE	RESULT	EXTERNAL	TEXT
1221328	2005-1-2	103999	260	3	1573	null	CURRICULUM_STAR	null	null	null
1221329	2005-1-2	103999	260	3	1573	null	PROBLEM_START	null	null	null
1221336	2005-1-2	103999	260	3	1573	1	ATTEMPT	null	igor/Assistn	####
1221340	2005-1-2	103999	260	3	1573	1	RESULT	correct	igor/Assistn	null
1221346	2005-1-2	103999	260	3	1573	null	PROBLEM_DONE	null	null	null

In order to summarize the data, we wrote a small script which produces the result in the following format:

UserID	Problem	Item	Result	Time	Question T	Item Time(	Condition
1573	igor/Assist	yr1999-25	1	2005-1	5	5	Scaffolding

Another advantage of the script is if the PROBLEM_END tag does not appear for some reason such as student do not finish a problem, or student jumps to some other curriculum, or some other technical problem, then the result is not taken in consideration. The following outline gives a source code for the script created.

```
import java.io.*;
import java.util.*;
import java.lang.*;
public class DataScraper {
 public static void main(String[] args) {
  if (args.length == 2) {
   try {
    FileInputStream fstream = new FileInputStream(args[0]);
    DataInputStream in = new DataInputStream(fstream);
    FileOutputStream out = new FileOutputStream(args[1]);
    PrintStream p = new PrintStream(out);
    String line = null;
    String newline = null;
    String[] brokenline = new String[23];
    String[] time = new String[3];
    int starttime = 0;
    int endfirst = 0;
    int endtime = 0;
    int start = 0;
    int dummy = 0;
    int dummy2 = 0;

    p.println("UserID\tProblem\tResult\tTime\tQuestion Time(sec)\tItem Time(sec)\tSection");

    while(in.available() != 0) {
     line = in.readLine();
     if(!line.equals("")){
      brokenline = line.split("\t");
      StringTokenizer st = new StringTokenizer(brokenline[1], " |.");
      String date = st.nextToken();
      int hours = Integer.parseInt(st.nextToken());
      int minutes = Integer.parseInt(st.nextToken());
      int seconds = Integer.parseInt(st.nextToken());
       if (brokenline[7].equals("PROBLEM_START")) {
        starttime = (3600 * hours) + (60 * minutes) + seconds;
        start = 1;
        dummy = 0;
       dummy2 = 0;
       }
      if (brokenline[7].equals("PROBLEM_DONE")) {
       if ((start == 1) && (dummy == 1)) {
        endtime = (3600 * hours) + (60 * minutes) + seconds;
        int x = endtime - starttime;
        int y = endfirst - starttime;
        newline = newline + "\t" + Integer.toString(y) + "\t" + Integer.toString(x);
        p.println (newline);
        start = 0;
        }
       }
      if(((brokenline[9].indexOf("behavior0.xml")) > 0) || ((brokenline[9].indexOf("0-behavior.xml")) > 0)) {
       if ((brokenline[7].equals("RESULT")) && (start == 1) && (dummy2 == 0)) {
        endfirst = (3600 * hours) + (60 * minutes) + seconds;
        newline = brokenline[5] + "\t" + brokenline[9] + "\t" + brokenline[8] + "\t" + brokenline[1];
        dummy = 1;
        dummy2 = 1;
        }
       }
      }
     }
     in.close();
     p.close();
    }
    catch (Exception e) {
     e.printStackTrace(System.out);
    }
   } else {
    System.out.println("Invalid parameters");
   }
  }
 }
```

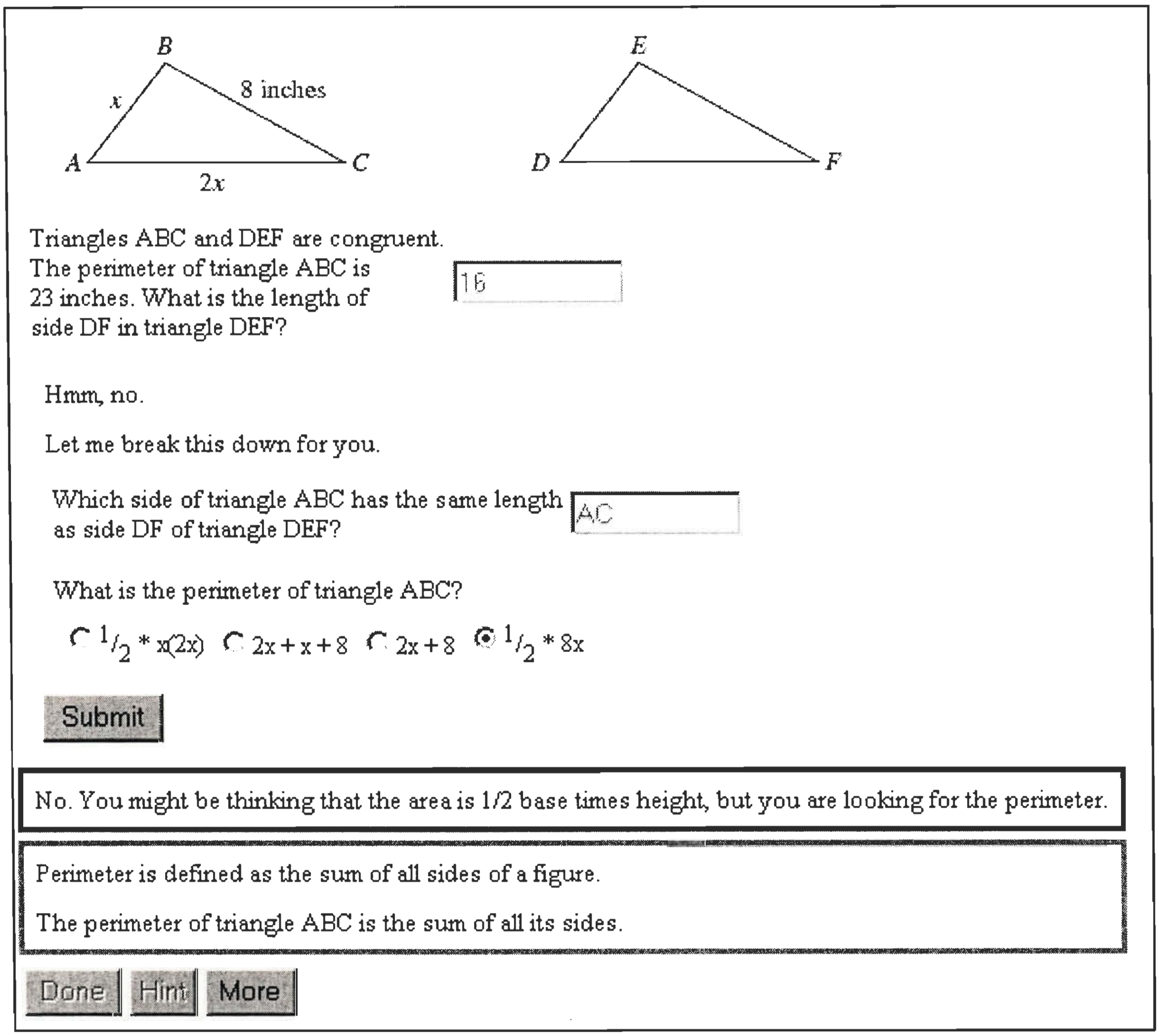
Bibliography

[BIK90] J. Bickmore-Brand. Scaffolding for improved mathematical understanding. Portsmouth: Heinemann, 1990

[VYG78] L. Vygotsky, M. Cole, V. John-Steiner, S. Scribner, and E. Souberman. Mind in Society. Cambridge: Harvard University Press, 1978

To best take advantage of this presentation on "Blending Assessment and Instructional Assisting"

1) Do this math problem



2) If you want to log in play with the assistments you can play student with these directions. At the end of the talk we look to see who has logged in.
   a. Go to www.assistment.org
   b. Click on the Amsterdam link to play student
      i. You will be given random problems
3) Later if you want to create a "Teacher" account, that will allow you to build your own content (medicine, physics, law, computer science) you can follow the following direction
   a. Movie showing how to create an account is at http://www.assistment.org/portal/project/videos/Neil_drescribing_teacher_account.html

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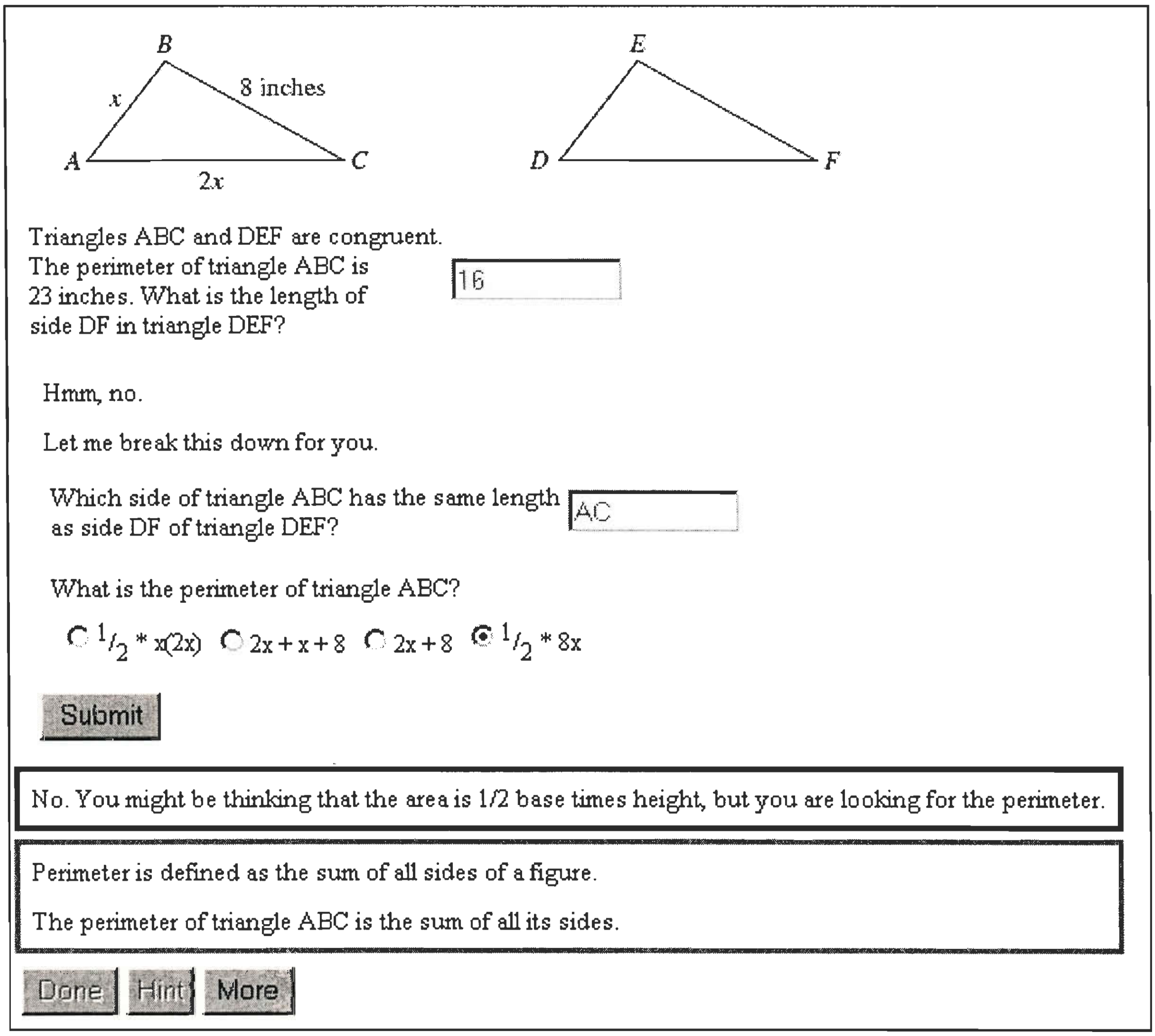

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   a. How to create yourself an account
   b. How to build assistments yourself (medicine, physics, law, computer science)

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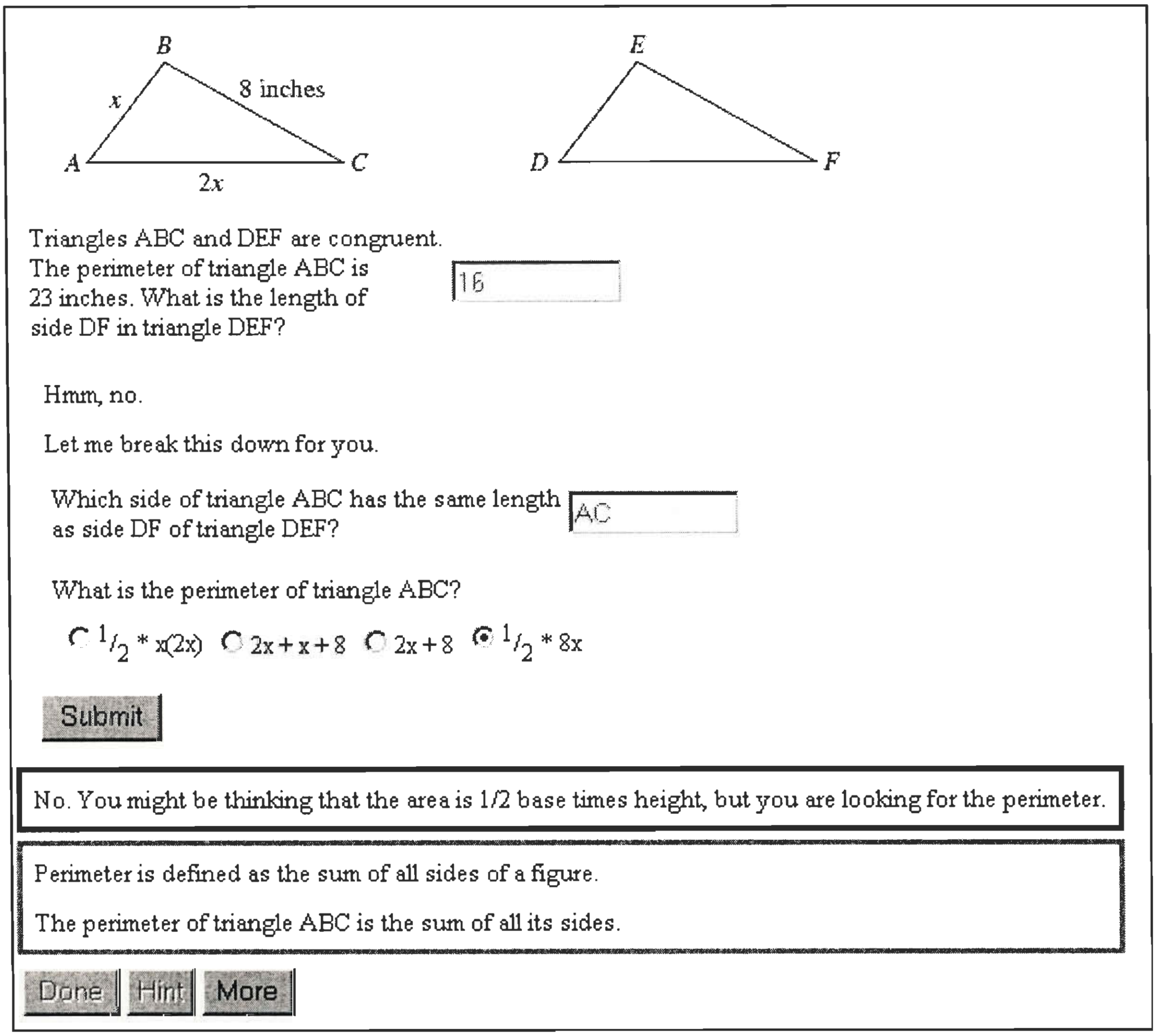
1) Do this math problem



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3) Later if you want to create a "Teacher" account, that will allow you to build your own content you can follow the following direction at http://www.assistment.org/portal/project/about.jsp to
   a. How to create yourself an account
   b. How to build assistments yourself (medicine, physics, law, computer science) http://nth.wpi.edu/neil/Video_and_DirectionsForTeachers.htm
   c. How to create an experiment.

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