April 2013

ASSISTments: Motivational Video Study

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Motivational Video Study

Interactive Qualifying Project completed in partial fulfillment
of the Bachelor of Science degree at
Worcester Polytechnic Institute, Worcester, MA

Submitted to:
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In Cooperation With
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Date: April 4, 2013

Advisor Signature

Co-advisor Signature
Abstract

ASSISTments, an online tutoring system developed at Worcester Polytechnic Institute, has been finding ways to improve student learning. The purpose of this motivational video study is to see if students do better in math problems if they watch motivational videos during the skillbuilders. We designed and built skillbuilders where students practice math problems as part of their homework. In the experimental condition, students get motivational videos when they get problems wrong. In the control, students do not get the videos. A between-subject analysis revealed that when viewing the motivational video students completed significantly more questions than when they did not. A review of homework completion rates did not reveal a reliable difference. However it is important to note that with so few assignments, differences in completion rates may not be meaningful. Overall, the study finds that motivational videos are effective in enhancing students’ persistence in doing their assignments.
# Authorship

<table>
<thead>
<tr>
<th>Section</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>ATH</td>
</tr>
<tr>
<td>Authorship</td>
<td>STK</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>ALL</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>STK</td>
</tr>
<tr>
<td>List of Tables</td>
<td>ALL</td>
</tr>
<tr>
<td>List of Figures</td>
<td>ATH</td>
</tr>
<tr>
<td>Introduction</td>
<td>ALL</td>
</tr>
<tr>
<td>Background</td>
<td>STK</td>
</tr>
<tr>
<td>Methodology</td>
<td>ALL</td>
</tr>
<tr>
<td>Results and Discussion</td>
<td>ALL</td>
</tr>
<tr>
<td>Conclusions and Recommendations</td>
<td>ALL</td>
</tr>
<tr>
<td>References</td>
<td>ATH</td>
</tr>
<tr>
<td>Appendices</td>
<td>STK</td>
</tr>
<tr>
<td>Appendix A: Documentation &amp; Problem Sets Created by Aung Thu Htet</td>
<td>ATH</td>
</tr>
<tr>
<td>Appendix B: Documentation &amp; Problem Sets Created by Soe Thet Ko</td>
<td>STK</td>
</tr>
<tr>
<td>Appendix C: Data Analysis Spreadsheets</td>
<td>ALL</td>
</tr>
<tr>
<td>Appendix D: Powerpoint Advertisement for Study</td>
<td>ATH</td>
</tr>
<tr>
<td>Appendix A.1.1: 4.MD.3 Skill Documentation</td>
<td>ATH</td>
</tr>
<tr>
<td>Appendix A.1.2: 4.MD.3 Skill Sample Problem Print</td>
<td>ATH</td>
</tr>
<tr>
<td>Appendix A.2.1: 5.MD.3 Skill Documentation</td>
<td>ATH</td>
</tr>
<tr>
<td>Appendix A.2.2: 5.MD.3 Skill Sample Problem Print</td>
<td>ATH</td>
</tr>
<tr>
<td>Appendix A.3.1: 5.MD.5c Skill Documentation</td>
<td>ATH</td>
</tr>
<tr>
<td>Appendix A.3.2: 5.MD.5c Skill Sample Problem Print</td>
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</tr>
<tr>
<td>Appendix A.4.1: 6.SP.1 Skill Documentation</td>
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</tr>
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<td>Appendix A.4.2: 6.SP.1 Skill Sample Problem Print</td>
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<td>Appendix B.1.1: 4.MD.4 Skill Documentation</td>
<td>STK</td>
</tr>
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<td>Appendix B.2.1: 5.MD.2 Skill Documentation</td>
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</tr>
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<td>STK</td>
</tr>
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<td>Appendix B.3.2: 6.SP.2 Skill Sample Problem Print</td>
<td>STK</td>
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</tr>
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<td>Appendix D: Powerpoint Advertisement for Study</td>
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Acknowledgements

We would like to thank a few key people who made this Interactive Qualifying Project a success. Our appreciation goes to Professor Neil Heffernan, who gave supervision in running this study, and Mrs. Cristina Heffernan, who committed a great amount of time in reviewing all of the ASSISTments problems we created, and helped us obtain statistical data from classrooms. We would also like to extend our thanks to Ms. Kim Kelly, a PhD student, who helped us analyze the acquired data and offered us valuable advice in writing our report.
# Table of Contents

Abstract ........................................................................................................................................... 2  
Authorship ....................................................................................................................................... 3  
Acknowledgements ......................................................................................................................... 4  
Table of Contents ............................................................................................................................ 5 
List of Tables .................................................................................................................................. 7  
List of Figures ................................................................................................................................. 8  
Introduction ..................................................................................................................................... 9  
Background ................................................................................................................................... 13  
Methodology ................................................................................................................................. 16  
Results and Discussion ................................................................................................................. 20  
Conclusions and Recommendations ............................................................................................. 26  
References ..................................................................................................................................... 27  
Appendices .................................................................................................................................... 29  
  Appendix A: Documentation & Problem Sets Created by Aung Thu Htet .................................. 29  
  Appendix B: Documentation & Problem Sets Created by Soe Thet Ko ................................. 30  
  Appendix C: Data Analysis Spreadsheets ............................................................................... 31  
  Appendix D: Powerpoint Advertisement for Study ............................................................... 31  
    Appendix A.1.1: 4.MD.3 Skill Documentation .................................................................... 32  
    Appendix A.1.2: 4.MD.3 Skill Sample Problem Print ......................................................... 41  
    Appendix A.2.1: 5.MD.3 Skill Documentation .................................................................... 48  
    Appendix A.2.2: 5.MD.3 Skill Sample Problem Print ........................................................ 50  
    Appendix A.3.1: 5.MD.5c Skill Documentation .................................................................. 52  
    Appendix A.3.2: 5.MD.5c Skill Sample Problem Print ........................................................ 56  
    Appendix A.4.1: 6.SP.1 Skill Documentation ...................................................................... 62  
    Appendix A.4.2: 6.SP.1 Skill Sample Problem Print ........................................................... 65  
    Appendix B.1.1: 4.MD.4 Skill Documentation .................................................................... 69  
    Appendix B.1.2: 4.MD.4 Skill Sample Problem Print ........................................................ 72  
    Appendix B.2.1: 5.MD.2 Skill Documentation .................................................................... 74  
    Appendix B.2.2: 5.MD.2 Skill Sample Problem Print ........................................................ 79  
    Appendix B.3.1: 6.SP.2 Skill Documentation ...................................................................... 83
List of Tables

Table 1: Common Core State Standard and Corresponding Problem Set ID ........................................ 18
Table 2: Student Participation Statistics .................................................................................................. 21
Table 3: Student Attempt and Z-Score Statistics .................................................................................... 22
Table 4: Data Analysis of Students who did both Experimental and Control Studies .................. 24
List of Figures

Figure 1: PowerPoint Advertisements Showing Common Core State Standards used in building Problem Sets (top), and Sample Motivational Videos (Bottom) .................................................. 15
Figure 2: Skillbuilder Problem Set Flowchart ............................................................................. 19
Introduction

The relationship between motivation, affect and student performance in intelligent tutoring systems (ITS) has been explored (Arroyo et al., 2009; Conati & Maclaren, 2009; Forbes-Riley & Litman, 2011; Robison et al., 2009). Researchers have established the need to address affect to increase student engagement within ITS (De Vicente & Pain, 2002; Graesser et al., 2008;). As a result, many research groups are focusing on detecting disengagement and responding to within the system to re engage the learner (Burleson & Picard, 2007; Chaffar et al. 2009; Conati & Maclaren, 2009; D'Mello et al., 2010; Robison et al. 2009). However, these are complex systems, some having costly sensors. Additionally, they focus on system use within the classroom rather than when being used for homework. An alternative approach is to embed videos into a homework assignment to increase student motivation and therefore persistence (Kelly et al., 2013).

The present study uses ASSISTments, an intelligent tutoring system, to deliver a homework assignment with embedded motivational videos. Thousands of students currently use this system to complete nightly homework, successfully increasing student performance (Mendicino et al., 2009; Kelly et al, 2013). The “skill builder” feature within ASSISTments has been found to improve student learning. To complete such an assignment, students must demonstrate mastery of a skill by completing three consecutive questions correctly. To improve performance on such a task, student perseverance is essential. Therefore increasing a student’s willingness to complete as many questions as necessary to complete an assignment is critical to student learning.

It has been determined that “grit”, or perseverance, is essential to success in a variety of domains (Duckworth et al., 2007). This suggests that interventions that positively impact grit and
increase persistence, might lead to higher long-term learning gains. As a result, the present study provides an intervention intended to target grit. Measures of perseverance include homework completion (Fredricks et al., 2011) or in this case, the number of questions completed.

In the United States, many teachers from middle schools use math textbooks as their principal teaching tool. ASSISTments has introduced the idea of incorporating textbooks with online tutoring system. This enables teachers to assign problem sets to students electronically, and have access to students’ progress and grades, which are automatically taken care of in ASSISTments tools. Not only the teachers get such feedbacks but also the students obtain instant feedbacks on every problem set they do. The main goal is for ASSISTments to be a tool used by teachers in order to help students have better success in their schools’ respective mathematics curriculums.

For our study, we created skillbuilder problem sets by following the guidelines set forth in the Common Core Standards. The Common Core Standards are based on the criteria laid down by the states. The standards are carefully designed by teachers, parents and community leaders to reflect what skills students should learn for specific grade levels. The following is a list of some state standards we base our skillbuilders upon:

- 4.MD.3  Area and Perimeter
- 4.MD.4  Interpreting Statistical Data (Addition and Subtraction using Fraction)
- 5.MD.2  Interpreting Statistical Data (Fraction)
- 5.MD.3  Volume of Rectangular Prism
- 5.MD.5c Adding Volume of Rectangular Prisms
- 6.SP.1  Recognizing Statistical Questions
- 6.SP.2  Understanding Statistical Data
6.SP.3 Interpreting Statistical Data

In order to keep track of every skillbuilder problem set we built and to organize their content, we thoroughly documented all the problem sets. Such documentation provides an explanation of different types of assistments that can be found in each skillbuilder problem set. Besides, the documentation ensures to keep our study organized and keep track of all the content created. All the documentations and screenshots of problem sets used in the study can be found in Appendix A and Appendix B. In documenting each problem set, we recorded the assistment number of the problem set, the number of assistment templates used in the problem set, the assistment numbers of those templates, a screenshot of what each assistment looks like in the test drive, and a list of the properties of each template. The properties give detail information such as type of the problem (standard or variablized), the variables in the problem, possible ranges of variables, and the expected type of answers such as arithmetic and multiple choice.

In addition to the documentation of the problem sets, we created an advertisement powerpoint that demonstrates each problem set with screenshot. By looking at the powerpoint, participating teachers can have a quick and easy look at how the problem sets look like before assigning to their students. The powerpoint included in the Appendix D provides the purpose and overview of the study, representations of what motivational videos look like, screenshots of test drive of the problem sets, and next steps for teachers to take to assign the problem sets to their students.

The powerpoint also has internal links so that teachers can easily navigate from one problem set to another. The first page contains the content, in which all the problem sets are not only listed but also linked to the respective pages. The thumbnails of motivational videos are also linked to the actual videos so that teachers can preview prior to giving assignments. The home
button on the lower left corner will take the viewer back to the beginning slide and the ‘next slide’ button goes to subsequent slide. The use of the powerpoint advertisement gives teachers an opportunity to easily view all the assitments which will be given to the students in the study.
Background

ASSISTments, an online math tutoring system, was founded by Professor Neil Heffernan in 2003. It was intended to help teachers and students have a better teaching and learning experience. The goal of ASSISTments system is to provide an easily accessible aid to improve the traditional classroom learning experience. Since its inception, ASSISTments has been growing as a successful web-based tutoring system with the funding from the U.S. Department of Education, the National Science Foundation, and the Bill and Melinda Gates Foundation. To improve the effectiveness of teaching and learning through ASSISTments online tutoring system, several studies such as ours have been implemented and many more will be. These studies provide ASSISTments with valuable guidelines to expand as a more successful and more effective tutoring systems for students not only across the U.S but also around the world.

ASSISTments has gained much success by creating original content for teachers to assign students from their classroom. Another step is to build content using other resources such as textbooks and Common Core Standard guidelines. Up until recently, many schools utilize hardcopy textbooks as primary teaching resources. However, lately ASSISTments have gained attention from many schools in the United States through advertisements. Several schools around the country have become interested in relying on ASSISTments as a tool to improve not only the learning experience of students but also the tutoring experience of teachers. Through discussions with teachers and administrative personnel from various schools, ASSISTments has been constantly trying to find ways to offer the best web-based tutoring tools. To fulfill this goal, many studies have been carried out and the ASSISTments system has been improved tremendously according to the findings from the studies.
ASSISTments, as an online tutoring system, has been of great help for teachers to tutor their students more effectively. Since ASSISTments is an online tutoring system that takes care of grading, progress report, and so on, the system is a great help to many teachers, particularly in grading assignments. By using ASSISTments tutoring system, teachers no longer need to spend a lot of time grading homework assignments, and giving feedbacks. Hence, ASSISTments allows teachers to spend extra time on other aspects of the class, thereby improving teaching and learning experiences of the class. In addition, by utilizing effective ASSISTments tools, teachers can better assess the academic success of the class in several areas of curriculum.

As mentioned above, ASSISTments has set a goal to integrate materials from other resources in addition to creating original content. The skills used in our study are based on Common Core guidelines as a partial fulfilment of this goal. The primary purpose of our study is to determine whether students do better in assignments and have desire to work harder if they see motivational videos while working on the problem sets. To serve this purpose, we include a normal video for control condition in our problem sets. Using statistical functions, the overall performance of the two groups is to be compared to assess the effectiveness of motivational videos. The results obtained from our study will aid ASSISTments in accomplishing its goal of improving the overall learning experiences. Surely, the success of our study will bring many advantages to not only teachers and students. And, this has become a primary motivation to conduct our motivational video study.
New Skill Builder Content with motivational videos for measuring volume, area, and perimeter. Understanding and interpreting statistical data content. Help us learn if motivational videos affect learning. Half the students get motivational videos and hints, while the other half just get hints.

4.MD.3 Area and Perimeter
4.MD.4 Interpreting Statistical Data (Addition and Subtraction using Fraction)
5.MD.2 Interpreting Statistical Data (Fraction)
5.MD.3 Volume of Rectangular Prism
5.MD.5c Adding Volume of Rectangular Prisms
6.SP.1 Recognizing Statistical Questions
6.SP.2 Understanding Statistical Data
6.SP.3 Interpreting Statistical Data

To learn what to do next, click here
If you have any questions e-mail assistments@wpi.edu

These are the videos your students will see if they are selected at random to get motivational videos. They see one when they start and then they also see videos when they get a problem wrong.

Figure 1: PowerPoint Advertisements Showing Common Core State Standards used in building Problem Sets (top), and Sample Motivational Videos (Bottom)
Methodology

The content used to build our problem sets are based on Common Core Standards so it reflects the necessary knowledge and learning skills that 5th, 6th, and 7th graders should have. Moreover, the content is designed in order to be relevant to the real-world problems.

In our study, 144 students in 5th, 6th, and 7th grades from several schools in Massachusetts participated as an assignment in their math class. All of our problem sets are designed so that participating students can fall into either experimental condition, in which students get to watch motivational videos, or control condition, in which they watch a regular video. Assigning students to experimental or control group in this random fashion ensures that the two groups are balanced with students of different academic backgrounds.

In experimental condition, students see an introductory video to get them motivated throughout the skillbuilder problem set. This video is accompanied by a brief motivating statement: “Think about how important it is to work hard”. There can be two responses to the video. Students can say they are ready or they had technical difficulties in case if they did not see the video. This way, we can take out of consideration those who had technical difficulties in our study. After watching the introductory video, students begin to work for a series of assistments. This series of problems start with five special assistments that provide students with not only hints but also scaffolding. This scaffolding incorporates a motivational video to motivate students when they get the problem wrong. When they get a wrong answer, they get a chance to watch a motivational video, accompanied by a short statement of encouragement:

“Even though you got the problem wrong, you can learn this. Read the hints provided for this one if you need to, it will not count against you. Then try again for the 3 right in a row!”:
Students can respond to the video in degrees of inspiration they got or they can also respond they had technical difficulties if they could not see the video. They can answer as follows:

This video is very much inspiring.
This video is somewhat inspiring.
This video is not quite inspiring.
I had technical difficulties.

After watching the short motivational video, students can choose to use the hints provided in the problem or they can try finishing the problem on their own. If the students do not get three right in a row after working out five of these special motivational video assistments, they have to continue working on random regular assistments which do not have any scaffolding with motivational videos. These regular assistments, however, provide students with hints.

In control condition, students watch an opening video of a teacher saying that the problem set is a skillbuilder problem set so students will have to work until they get three problems right in row. There can be two responses to this video. The student can either say they saw the video or say they had technical difficulties in case if they could not see the video. This response is recorded so that we can eliminate the students who had technical difficulties in our study. After watching this normal introductory video, students are asked to work out random assistments. These random assistments are regular assistment problems with no videos. There is no scaffolding in these regular assistments. However, the students can still have access to hints. When they get three assistments right in a row, they finish the skillbuilder problem set.
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Figure 2: Skillbuilder Problem Set Flowchart
Results and Discussion

Our obtained data can be found in Appendix C. This raw data contains comprehensive information such as student name, teacher name, problem sequence ID, assistments ID, student’s answer, completion status and so on for all of our problem sets.

Since the raw data contains extraneous information that is not pertinent to our study, we refined the data so that there are four columns each for seven problem sets (total of 28 columns) for each student. The four columns comprise the first problem ID done by the student, the answer for this first problem, the number of attempts the student made for the problem set, and completion status of the problem set.

Next, each of the seven problem sets is analyzed separately in Excel. For each problem set, the following is calculated:

- Total number of students
- Number of students in experiment
- Number of students in control
- Number of students in experiment (with no technical difficulties)
- Number of students in control (with no technical difficulties)
- Average number of attempts by students in experiment (with no technical difficulties)
- Average number of attempts by students in control (with no technical difficulties)
- Ttest to compare the average number of attempts of two groups
- Z-Score for students in experiment (with no technical difficulties)
- Z-Score for students in control (with no technical difficulties)
- Ttest to compare the Z-Scores of two groups

The data analysis is summarized in Table 2 and Table 3.
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<td>42</td>
<td>76</td>
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<td>40</td>
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<td>17</td>
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<td>10</td>
<td>21</td>
<td>12</td>
<td>11</td>
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<td>Number of Students in Control with No Technical Difficulty</td>
<td>7</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>7</td>
<td>9</td>
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### Table 3: Student Attempt and Z-Score Statistics

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<td>Number of Students in Experiment who Complete (No Tech Diff)</td>
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<td>9</td>
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<td>7</td>
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<td>6</td>
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<td>8</td>
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<td>Average Number of Attempts by Students in Experiment (No Tech Diff)</td>
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<td>5</td>
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<td>7.58</td>
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As seen in Table 2, in both control and experimental groups, there were students who were not able to watch the videos due to technical difficulties. About half or more students were not able to watch motivational videos. We had to exclude those students from the study and take into consideration only the students who did not have technical difficulties.

In Table 3, the data is analyzed for students who did not have any technical difficulties. By comparing the results in the rows, average number of attempts by students in experiment and average number of attempts by students in control, we can see that students in experiment, who watched motivational videos, have in general higher average number of attempts than students in control.
control who did not watch any motivational videos. This result means that students who watched motivational videos tend to persist in doing problem sets than those who did not watch motivational videos.

The Z-scores for each of the study were also computed in Excel and shown in Table 3. The t-test values of the Z-scores and those of the average number of attempts are found to be the same. This also validates the result that the motivational videos are effective in student’s persistence.
Table 4: Data Analysis of Students who did both Experimental and Control Studies

<table>
<thead>
<tr>
<th></th>
<th>Average Z score for Control</th>
<th>Average Z score for Experiment</th>
<th>Completion (Control)</th>
<th>Completion (Experiment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>student 2</td>
<td>-0.06645</td>
<td>0.002516</td>
<td>0.333333</td>
<td>0.5</td>
</tr>
<tr>
<td>student 18</td>
<td>-0.36275</td>
<td>-0.54269</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>student 24</td>
<td>-0.49274</td>
<td>0.004962</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>student 42</td>
<td>0.259702</td>
<td>-0.04497</td>
<td>0.666667</td>
<td>1</td>
</tr>
<tr>
<td>student 59</td>
<td>-0.0006</td>
<td>1.595685</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>student 65</td>
<td>-0.62134</td>
<td>0.724587</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>student 67</td>
<td>0.050023</td>
<td>0.596986</td>
<td>0.75</td>
<td>1</td>
</tr>
<tr>
<td>student 68</td>
<td>-1.34258</td>
<td>-0.65548</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>student 69</td>
<td>0.428859</td>
<td>0.476264</td>
<td>0.666667</td>
<td>0.333333</td>
</tr>
<tr>
<td>student 70</td>
<td>-0.3749</td>
<td>0.032275</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>student 72</td>
<td>1.83126</td>
<td>1.133553</td>
<td>0.666667</td>
<td>0</td>
</tr>
<tr>
<td>student 75</td>
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<td>-0.58008</td>
<td>0</td>
<td>0.666667</td>
</tr>
<tr>
<td>student 78</td>
<td>-0.57374</td>
<td>-0.11083</td>
<td>0.8</td>
<td>1</td>
</tr>
<tr>
<td>student 82</td>
<td>-0.39653</td>
<td>0.05741</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>student 86</td>
<td>-0.42877</td>
<td>1.518821</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>student 96</td>
<td>-0.05367</td>
<td>-0.13743</td>
<td>0.75</td>
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<td>student 122</td>
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<td>student 129</td>
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<td>-0.48483</td>
<td>0.333333</td>
<td>1</td>
</tr>
<tr>
<td>student 131</td>
<td>-1.07157</td>
<td>1.656902</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>student 142</td>
<td>-0.42877</td>
<td>1.204982</td>
<td>1</td>
<td>0.666667</td>
</tr>
<tr>
<td>T-test for average Z-scores</td>
<td>0.005048</td>
<td>T-test for completion</td>
<td>0.773901</td>
<td></td>
</tr>
</tbody>
</table>
Out of all students in the study, only students who did both control studies and experimental studies were considered in Table 4. Among all the problem sets they work on, we only take into consideration the problem sets in which they did not have any technical difficulties. In the table, the average Z-score for the control problem sets and the average Z-score for experimental problem set can be compared. The completion columns indicate the fraction of how many problems they finished out of total control problem sets and experimental problem sets respectively. Then, we compute the T-test of average Z-scores and T-test of completion to see if there is significant difference between the two groups. The paired t-test of average Z-scores reveals that students who watch motivational videos completed more questions than those who did not watch any motivational videos. But the t-test analysis of homework completion rates shows that there is no significance difference. However it is important to note that with so few assignments, differences in completion rates may not be meaningful.
Conclusions and Recommendations

According to this motivational video study, we can conclude that motivational videos are effective in enhancing student’s persistence. We discovered that the average number of attempts by students who watch motivational videos is generally higher than that by students who did not watch any motivational videos. Although this result does not guarantee higher completion rate, higher persistence shown by students is a very promising sign, and this suggests that incorporating motivational videos into future assistments would be beneficial to students.

Re-running the study with a larger student population is recommended. In our study, a total of 145 students took part in seven motivational video studies. However, many of the students had technical difficulties and therefore removed in the analysis of each problem set. In the final analysis which take into consideration all seven problem sets, only students who participated in both experimental and control studies without technical difficulties were included, and the student population size drops to 23. Unfortunately, the proportion of students removed is a large number, and therefore future studies should address the causes of these technical difficulties to decrease the attrition rate.
References


Appendices

Appendix A: Documentation & Problem Sets Created by Aung Thu Htet

This appendix includes detailed documentation on the assistment templates created by Aung Thu Htet. Examples of parent assistments for each problem set are shown in the documentation. For each skill, the documentation is followed by the printout of the problem sets.

<table>
<thead>
<tr>
<th>Skills</th>
<th>Links</th>
</tr>
</thead>
</table>
| 4.MD.3 - Area and Parameter | [http://goo.gl/zqBSb](http://goo.gl/zqBSb) (DOC)  
[http://goo.gl/xcET7](http://goo.gl/xcET7) (Problem Set Print) |
| 5.MD.3 - Volume of Rectangular Prism | [http://goo.gl/HCuCC](http://goo.gl/HCuCC) (DOC)  
[http://goo.gl/t5vj0](http://goo.gl/t5vj0) (Problem Set Print) |
[http://goo.gl/tW7tW](http://goo.gl/tW7tW) (Problem Set Print) |
[http://goo.gl/KOdJ0](http://goo.gl/KOdJ0) (Problem Set Print) |
Appendix B: Documentation & Problem Sets Created by Soe Thet Ko

This appendix includes detailed documentation on the assimtment templates created by Soe Thet Ko. Examples of parent assistments for each problem set are shown in the documentation. For each skill, the documentation is followed by the printout of the problem sets.

<table>
<thead>
<tr>
<th>Skills</th>
<th>Links</th>
</tr>
</thead>
</table>
http://goo.gl/TAkj3 (Problem Set Print) |
| 5.MD.2 - Interpreting Statistical Data (Fraction) | http://goo.gl/FLp6B (DOC)  
http://goo.gl/6JNh (Problem Set Print) |
| 6.SP.2 - Understanding Statistical Data           | http://goo.gl/2zT5A (DOC)  
http://goo.gl/dNFSb (Problem Set Print) |
| 6.SP.3 - Interpreting Statistical Data            | http://goo.gl/Qv6Bh (DOC)  
http://goo.gl/BAMwy (Problem Set Print) |
Appendix C: Data Analysis Spreadsheets

This appendix includes the pdf files of data analysis for each of the problem set, and the excel sheet of the final analysis data.

5.MD.3 Volume of Rectangular Prism (problem set id 84903) - http://goo.gl/GplXv
6.SP.1 Recognizing Statistical Questions (problem set id 91599) - http://goo.gl/mRoGn
5.MD.2 Interpreting Statistical Data (Fraction) (problem set id 91600) - http://goo.gl/dDtP8
6.SP.3 Interpreting Statistical Data (problem set id 91601) - http://goo.gl/tEBxD
5.MD.5c Adding Volume of Rectangular Prisms (problem set id 91602) - http://goo.gl/8wmI4
6.SP.2 Understanding Statistical Data (problem set id 91605) - http://goo.gl/eYxdN
4.MD.3 Area and Perimeter (problem set id 91607) - http://goo.gl/K0jjo
Final Data Analysis - http://goo.gl/BKH0l

Appendix D: Powerpoint Advertisement for Study

This appendix contains the powerpoint advertisement for motivational video studies on eight common core standards. The powerpoint documents representative problems that students will solve for each of the standard.

Links: http://goo.gl/kPFtk (pdf)

http://goo.gl/Auwv9 (Presentation)
### Appendix A.1.1: 4.MD.3 Skill Documentation

<table>
<thead>
<tr>
<th>Skill</th>
<th>Grade</th>
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<tr>
<td>4.MD.3, Area &amp; Perimeter of Rectangle in Real World Problems</td>
<td>4.MD.3</td>
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#### THE MASTERY SET (AREA)

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#### THE MASTERY SET (PERIMETER)

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<th>Number of Attempts</th>
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#### THE MASTERY SET (PERIMETER AND AREA)

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<table>
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<th>Number of Attempts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>10</td>
</tr>
</tbody>
</table>
Templates:

344066

Assessment ID: 344066

A rectangular window has length 4 feet, and width 3 feet. If a window pane measures 1 foot by 1 foot, how many window panes would fit in the window?

Type your answer below (mathematical expression):

Submit Answer  Show Hint 1 of 3

- The context in this template is variabilized. The rectangular enclosure can be a brownie pan, floor of a room, window, a piece of land, a roof, or a piece of paper.
- The length and width of the context are also variabilized with the function rand(), while keeping the numbers practical in real world
- The unit object to be counted can be brownie, tile, window pane, moss mat, solar panel, or colored sticker respectively to the previously mentioned contexts.
A solar panel measures 1 foot by 1 foot. If a rectangular roof has length 15 feet, and width 7 feet, how many solar panels would fit in the roof?

Type your answer below (mathematical expression):

The context in this template is variabilized. The rectangular enclosure can be a pen, brownie pan, floor of a room, window, a piece of land, a roof, or a piece of paper.

The length and width of the context are also variabilized with the function rand(), while keeping the numbers practical in real world

The unit object to be counted can be brownie, sheep, tile, window pane, moss mat, solar panel, or colored sticker respectively to the previously mentioned contexts.
A rectangular pen has length 14 meters, and width 5 meters. If a llama needs a 1 meter by 1 meter of space, how many llamas would fit in the pen?

Type your answer below (mathematical expression):

Submit Answer  Show Hint 1 of 3

- The rectangular enclosure is fixed as pen.
- The length and width of the pen are also variabilized with the function rand(), while keeping the numbers practical in real world
- The animal to be counted can be goats, cows, pigs, or llamas.
A sheep needs a 1 meter by 1 meter space, and 80 sheep fit in a rectangular pen. If the length of the pen is 10 meters, what would be its width in meters?

Type your answer below (mathematical expression):

The context in this template is variabilized. The rectangular enclosure can be a pen, brownie pan, floor of a room, window, a piece of land, a roof, or a piece of paper.

The length is variabilized with the function rand(), while keeping it practical in real world.

The unit objects in the enclosure can be sheep, brownie, tile, window pane, moss mat, solar panel, or colored sticker respectively to the previously mentioned contexts.

The number of objects in the enclosure is also variabilized with practical numbers.
A solar panel measures 1 foot by 1 foot, and 165 solar panels fit in a rectangular roof. If the width of the roof is 11 feet, what would be its length in feet?

Type your answer below (mathematical expression):

The context in this template is variabilized. The rectangular enclosure can be a pen, brownie pan, floor of a room, window, a piece of land, a roof, or a piece of paper.

The width is variabilized with the function rand(), while keeping it practical in real world.

The unit objects in the enclosure can be sheep, brownie, tile, window pane, moss mat, solar panel, or colored sticker respectively to the previously mentioned contexts.

The number of objects in the enclosure is also variabilized with practical numbers.
A rectangular swimming pool area has length 20 feet, and width 12 feet. If we want to put fence along the four sides of the swimming pool area, find how many feet of the fence should we need.

Type your answer below (mathematical expression):

- The context in this template is variabilized. The rectangular enclosure can be pen, brownie pan, floor of a room, window, piece of land, swimming pool area, or cake.
- The length and width of the context are also variabilized with the function `rand()`, while keeping the numbers practical in real world.
- The enclosing object can be fence, icing trim, baseboards, casing, fence, fence, or frosting trim respectively to the previously mentioned contexts.
We need 38 inches of icing trim to put along all four sides of a rectangular brownie pan. If the length of the brownie pan is 13 inches, find the width.

Type your answer below (mathematical expression):

The context in this template is variabilized. The rectangular enclosure can be pen, brownie pan, floor of a room, window, piece of land, swimming pool area, or cake.

The length is variabilized with the function rand(), while keeping it practical in real world.

The enclosing object can be fence, icing trim, baseboards, casing, fence, fence, or frosting trim respectively to the previously mentioned contexts.

The perimeter is also variabilized with practical numbers.
Assessment ID: 348351

We need 12 feet of casing to put along all four sides of a rectangular window. If the width of the window is 2 feet, find the length.

Type your answer below (mathematical expression):

Submit Answer  Show Hint 1 of 3

- The context in this template is variabilized. The rectangular enclosure can be pen, brownie pan, floor of a room, window, piece of land, swimming pool area, or cake.
- The width is variabilized with the function rand(), while keeping it practical in real world.
- The enclosing object can be fence, icing trim, baseboards, casing, fence, fence, or frosting trim respectively to the previously mentioned contexts.
- The perimeter is also variabilized with practical numbers.
A rectangular pen has length 10 meters, and width 9 meters. If we want to put fence along the four sides of the pen, find how many meters of the fence should we need.

Algebra:

\[= 38\]

Hints:

- First, sketch a picture of a pen, and label its length and width with the given dimensions.

*Note: The figure is not to scale*

![Pen Sketch](image)

Here is a sketch of a pen with length 10 and width 9. Notice that there are two lengths and two widths in the rectangular pen in the figure. Since you want to cover all four sides, you need to calculate the total measurement of two lengths, and two widths.

\[
\text{The perimeter} = (2 \times \text{length}) + (2 \times \text{width})
\]

\[= (2 \times 10) + (2 \times 9)\]

\[= 38\]

Type in 38.
We need 48 feet of baseboards to put along all four sides of a rectangular floor of a room. If the length of the floor of a room is 14 feet, find the width.

**Algebra:**

\[ \checkmark 10 \]

**Hints:**

- First, sketch a picture of a floor of a room, and label its length and width with the given dimensions.

**Note : The figure is not to scale**

Here is a sketch of a floor of a room with length 14 and unknown width.

Notice that there are two lengths and two widths in the rectangular floor of a room in the figure.

You have the total measurement of two lengths, and two widths, which is the perimeter given.

- The perimeter \( = (2 \times \text{length}) + (2 \times \text{width}) \)

48 \( = (2 \times 14) + (2 \times \text{width}) \)

2 \( \times \text{width} \) \( = 48 - (28) \)

width \( = 10 \)

Type in 10.
3) Assignment #361777 "361777 - Area & Perimeter of Rectangle in Real World Problems (PERIMETER: find length)"

We need 46 feet of baseboards to put along all four sides of a rectangular floor of a room. If the width of the floor of a room is 11 feet, find the length.

**Algebra:**

\[ \checkmark \ 12 \]

**Hints:**

- First, sketch a picture of a floor of a room, and label its **length** and **width** with the given dimensions.
- 
  *Note: The figure is not to scale*

Here is a sketch of a floor of a room with width 11 and unknown length.

Notice that there are two lengths and two widths in the rectangular floor of a room in the figure.

You have the total measurement of two lengths, and two widths, which is the perimeter given.

- 
  *The perimeter*  
  \[ = (2 \times \text{length}) + (2 \times \text{width}) \]
  
  \[ \text{46} = (2 \times \text{length}) + (2 \times 11) \]
  
  \[ 2 \times \text{length} = \text{46} - \text{22} \]
  
  \[ \text{length} = \text{12} \]

Type in 12.
4) Assistance #361797 "361797 - Area & Perimeter of Rectangle in Real World Problems (AREA: find area)"

A moss mat measures 1 meter by 1 meter. If a rectangular piece of land has length 22 meters, and width 10 meters, how many moss mats would fit in the piece of land?

**Algebra:**

\[ \text{Area} = 22 \text{ m} \times 10 \text{ m} = 220 \text{ m}^2 \]

**Hints:**

- First, sketch a picture of a piece of land, and label its length and width with the given dimensions.

*Note: The figure is not to scale*

Here is a sketch of a piece of land with length 22 and width 10.

Since each moss mat fits into a square meters, you need to find the area in squared meters.

\[ \text{The area} = \text{length} \times \text{width} \]
\[ = 22 \text{ m} \times 10 \text{ m} \]
\[ = 220 \text{ m}^2 \]

Type in 220.
5) Assistance #361717 "361717 - Area & Perimeter of Rectangle in Real World Problems
(_AREA: find width)"

A brownie measures 1 inch by 1 inch, and 60 brownies fit in a rectangular brownie pan. If
the length of the brownie pan is 12 inches, what would be its width in inches?

**Algebra:**

✓ 5

**Hints:**
- First, sketch a picture of a brownie pan, and label its length and width.
- 
  \[ \text{Note: The figure is not to scale} \]

Here is a sketch of a brownie pan with length 12 and unknown width.

Since each brownie fits into a square inches, and you have the area 60, you need to find the
number which when multiplied by length 12 gives you the area 60.

- The area  = length \* width

60 inches \* inches  = 12 inches \* width

width  = 60 inches \* inches \div 12 inches

  = 5 inches

Type in 5.
A sheep needs a 1 meter by 1 meter space, and 65 sheep fit in a rectangular pen. If the width of the pen is 5 meters, what would be its length in meters?

**Algebra:**

✓ 13

**Hints:**

- First, sketch a picture of a pen, and label its length and width.

- Note: The figure is not to scale

Here is a sketch of a pen with width 5 and unknown length. Since each sheep fits into a square meters, and you have the area 65, you need to find the number which when multiplied by width 5 gives you the area 65.

- The area

\[65 \text{ meters}\times\text{meters} = \text{length} \times 5 \text{ meters}\]

\[\text{length} = \frac{65 \text{ meters}\times\text{meters}}{5 \text{ meters}}\]

\[= 13 \text{ meters}\]

Type in 13.
7) Assignment #361737 "361737 - Area & Perimeter of Rectangle in Real World Problems (only sheep)"

A rectangular pen has length 10 meters, and width 9 meters. If a cow needs a 1 meter by 1 meter of space, how many cows would fit in the pen?

Algebra:
✓ 90

Hints:
• First, sketch a picture of pen, and label its length and width with the given dimensions.

Note: The figure is not to scale

Here is a sketch of a pen with length 10 and width 9. Since each cow fits into a square meter, you need to find the area in meter squared.

The area = length * width

= 10 m * 9 m

= 90 m^2

Type in 90.
## Appendix A.2.1: 5.MD.3 Skill Documentation

<table>
<thead>
<tr>
<th>Skill</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.MD.3, Volume of Rectangular Prism</td>
<td>5.MD.3</td>
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</tbody>
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### THE MASTERY SET

<table>
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<table>
<thead>
<tr>
<th>Number to Master</th>
<th>Number of Attempts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>10</td>
</tr>
</tbody>
</table>
The small cube is a fixed (not variabilized) image that shows up on every problem in the template.
- There are 11 boxes (to scale) for this template.
- The boxes are variabilized images chosen from the set of 11.
Appendix A.2.2: 5.MD.3 Skill Sample Problem Print

1) Assistance #340054 "340054 - Measure Volume"

A small cube has length 1, width 1, and height 1.

How many small cubes would fit in the following box of length 2, width 7, and height 3?

Algebra:
✓ 42

Hints:
- Fill in one front row of the bottom of the box.
There would be 2 cubes in the front row.

- Now fill in the bottom area of the box.
  Try finding how many cubes would fit in the bottom area of the box.

There would be 14 cubes in the bottom area.

- You have the number of cubes in the bottom area 14, and the height of the box is 3.
  Fill in the whole box by adding up all 3 layers.

There would be 42 cubes.
Type in 42.
### Appendix A.3.1: 5.MD.5c Skill Documentation

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<tr>
<th>Skill</th>
<th>Grade</th>
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<tbody>
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<td>5.MD.5c. Relate volume to the operations of multiplication and addition</td>
<td>5.MD.5c</td>
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### THE MASTERY SET

<table>
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<table>
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<th>Number of Attempts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>10</td>
</tr>
</tbody>
</table>
There are all together 10 figures of combined rectangular prisms placed front and back.
The image in the question is a variabilized image that is selected from the set of 10 figures.
The length, width, and height of the prisms are given along with the figure.
The student needs to calculate the volume of each rectangular prism and add them together to obtain the total volume of the figure.
There are all together 10 figures of combined rectangular prisms placed side by side.
The image in the question is a variabilized image that is selected from the set of 10 figures.
The length, width, and height of the prisms are given along with the figure.
The student needs to calculate the volume of each rectangular prism and add them together to obtain the total volume of the figure.
There are all together 10 figures of combined rectangular prisms placed top to bottom.

The image in the question is a variabilized image that is selected from the set of 10 figures.

The length, width, and height of the prisms are given along with the figure.

The student needs to calculate the volume of each rectangular prism and add them together to obtain the total volume of the figure.
Appendix A.3.2: 5.MD.5c Skill Sample Problem Print

1) Assistment #341733 "341733 - Relate volume to the operations of multiplication and addition"

The length, width, and height of the rectangular prisms are given. Find the total volume of the figure below.

![Diagram of rectangular prisms]

**Algebra:**

\[ \text{Volume of prism A} = 7 \times 3 \times 2 = 42 \]

**Hints:**

- What would be the volume of the prism in the back?
The volume is length times width times height.

So the volume of prism A is \( 7 \times 3 \times 2 \).
- What would be the volume of the prism in the front?
The volume is length times width times height.

So the volume of prism B is $2 \times 2 \times 4$.

- Now you have the volume of prism in the back, which is 42, and the volume of prism in the front, which is 16.
- You can obtain the combined volume by adding the two volumes together.

The volume of combined prism is $42 + 16$.
- Type in 58.
2) Assignment #341765 "341765 - Relate volume to the operations of multiplication and addition (side-to-side)"

The length, width, and height of the rectangular prisms are given. Find the total volume of the figure below.

![Diagram of prisms]

**Algebra:**

✓ 58

**Hints:**

- What would be the volume of the right prism?
The volume is length times width times height.

![Diagram of right prism]

So the volume of prism A is 4 * 5 * 2.

- What would be the volume of the left prism?
The volume is length times width times height.

![Diagram of left prism]
So the volume of prism B is $3 \times 2 \times 3$.

- Now you have the volume of the right prism, which is 40, and the volume of the left prism, which is 18.

You can obtain the combined volume by adding the two volumes together.

The volume of combined prism is $40 + 18$.
Type in 58.
3) Assistment #341857 "341857 - Relate volume to the operations of multiplication and addition (top-to-bottom)"

The length, width, and height of the rectangular prisms are given. Find the total volume of the figure below.

![Diagram of prisms]

**Algebra:**

✔️ 64

**Hints:**

- What would be the volume of the bottom prism?
  The volume is length times width times height.
So the volume of prism A is $4 \times 2 \times 5$.
- What would be the volume of the top prism?
The volume is length times width times height.

![Diagram of prism A]

So the volume of prism B is $3 \times 4 \times 2$.
- Now you have the volume of the bottom prism, which is 40, and the volume of the top prism, which is 24.
You can obtain the combined volume by adding the two volumes together.

![Diagram of combined prism]

The volume of combined prism is $40 + 24$.
Type in 64.
## Appendix A.4.1: 6.SP.1 Skill Documentation

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<td>3</td>
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Templates:

331572

There are 10 statistical questions and 10 non-statistical questions prepared.
- The question A is selected from 10 non-statistical questions and the question B is selected from 10 statistical questions.
- The answer will always be B.

331573

There are 10 statistical questions and 10 non-statistical questions prepared.
- The question A is selected from 10 statistical questions and the question B is selected from 10 non-statistical questions.
- The answer will always be A.
There are 10 statistical questions and 10 non-statistical questions prepared.  
Question A is selected from 5 non-statistical questions and question B is selected from the other 5 non-statistical questions, so that the two questions will never be the same.  
The answer will always be Both A and B.

There are 10 statistical questions and 10 non-statistical questions prepared.  
Question A is selected from 5 statistical questions and question B is selected from the other 5 statistical questions, so that the two questions will never be the same.  
The answer will always be Neither A and B.
Which of the following is a statistical question?

A) **Do you have a pet?**

B) **What colors do your classmates like?**

Multiple choice:

- [x] A
- [ ] B
- [x] Both A and B
- [x] Neither A nor B

Hints:

- A **statistical question** anticipates variability, and may have several different answers. Try asking yourself how many different answers there are for each question.

If there is only one answer, it is not a statistical question.

- Question A can have **only one answer**.
- Question B can have **different answers** depending on who you ask.
- Question B is a **statistical question**. Select B.
Which of the following is a statistical question?

A) How tall are students in your class?

B) How many hours do you study daily?

Multiple choice:
✓ A
✗ B
✗ Both A and B
✗ Neither A nor B

Hints:
• A statistical question anticipates variability, and may have several different answers. Try asking yourself how many different answers there are for each question.

If there is only one answer, it is not a statistical question.
• Question B can have only one answer.
  Question A can have different answers depending on who you ask.
• Question A is a statistical question. Select A.
A statistical question anticipates variability, and may have several different answers. Try asking yourself how many different answers there are for each question.

If there is only one answer, it is not a statistical question.

- Both questions can have only one answer.
- Neither question A nor question B is a statistical question. Select Neither A nor B.
Which of the following is a statistical question?

A) Where do your classmates want to go for summer va

B) In which months were your classmates born?

Multiple choice:

- A
- B
- Both A and B
- Neither A nor B

Hints:

- A statistical question anticipates variability, and may have several different answers. Try asking yourself how many different answers there are for each question.

If there is only one answer, it is not a statistical question.

- Both questions can have different answers depending on who you ask.

- Both question A and question B are statistical questions. Select both A and B.
### Appendix B.1.1: 4.MD.4 Skill Documentation

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</table>
There are 8 line plots for this template.
Students measure objects in their desks and the data are shown in the line plot below. If the objects are to be connected end to end, what would be the total length?

Length of Objects (in inches)

Type your answer below (mathematical expression):

- There are 8 line plots for this template.
Appendix B.1.2: 4.MD.4 Skill Sample Problem Print

1) Assistment #368015 "368015 - 57508 - Fraction (Subtraction)"

The measurements of 8 different insect specimens are shown in the line plot below. Determine the difference in length between the longest and the shortest specimens.

Algebra:

\[ 0.625 \]

Hints:

• The difference in length is obtained by subtraction of the minimum value from the maximum value. First, try to identify the minimum value and the maximum value of the data points.

• The maximum is \( \frac{3}{4} \), and the minimum is \( \frac{1}{8} \)

• Difference = \( \frac{3}{4} - \frac{1}{8} = \frac{5}{8} \)

Type \( \frac{5}{8} \)
2) Assignment #368086 "368086 - 57508 - Fraction (Addition)"

Students measure objects in their desks and the data are shown in the line plot below. If the objects are to be connected end to end, what would be the total length?

Length of Objects (in inches)

Algebra:
✓ 3 3/8

Hints:
• To get the total length, add up the values of all data points. There are 8 data points in the plot.

\[
\text{Total} = \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8}
\]

• Total length = \[\frac{27}{8}\]

Type \[\frac{27}{8}\]

(or) 3 3/8
### Appendix B.2.1: 5.MD.2 Skill Documentation

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Templates Used: All

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Templates Used: 343205

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Templates Used: 346732
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Templates Used: 347131
The measurements of 8 different insect specimens are shown in the line plot below. Determine the difference in length between the longest and the shortest specimens.

Length of Insect (in inches)

Type your answer below (mathematical expression):

- There are 8 line plots for this template.
Students measure objects in their desks and the data are shown in the line plot below. If the objects are to be connected end to end, what would be the total length?

![Line plot with objects represented by asterisks at positions 1/8, 1/4, 3/8, 1/2, 5/8, 3/4, 7/8.]

Length of Objects (in inches)

Type your answer below (mathematical expression):

- There are 8 line plots for this template.
The following line plot shows the amount of orange juice in liters in 8 jugs. How much liquid will each jug contain if distributed equally?

Amount of Orange Juice (in liters)

• There are 8 line plots for this template.
Appendix B.2.2: 5.MD.2 Skill Sample Problem Print

1) Assisment #365612 "365612 - 57508 - Fraction (Subtraction)"

The measurements of 8 different insect specimens are shown in the line plot below. Determine the difference in length between the longest and the shortest specimens.

![Line plot of insect measurements]

**Algebra:**

0.375

**Hints:**

- The difference in length is obtained by **subtraction** of the **minimum** value from the **maximum** value. First, try to identify the minimum value and the maximum value of the data points.

- The maximum is \( \frac{3}{4} \), and the minimum is \( \frac{3}{8} \)

- Difference = \( \frac{3}{4} - \frac{3}{8} = \frac{3}{8} \)

Type \( \frac{3}{8} \)
2) Assistment #365669 "365669 - 57508 - Fraction (Addition)"

Students measure objects in their desks and the data are shown in the line plot below. If the objects are to be connected end to end, what would be the total length?

![Line plot showing lengths of objects in inches: 1/8, 1/4, 3/8, 1/2, 5/8, 3/4, 7/8.]

**Algebra:**

\[ \text{Total length} = \frac{11}{4} \]

**Hints:**

- To get the total length, add up the values of all data points. There are 8 data points in the plot.

\[ \frac{1}{8} + \frac{1}{8} + \frac{3}{8} + \frac{3}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{11}{4} \]

Type \[ \frac{11}{4} \]

(or) 2 3/4
The following line plot shows the amount of orange juice in liters in 8 jugs. How much liquid will each jug contain if distributed equally?

**Amount of Orange Juice (in liters)**

| 1/8 | 1/4 | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 |

**Algebra:**

\[ \text{mean} = \frac{\text{sum}}{\text{count}} \]

**Hints:**

- "Having the liquid distributed equally" implies "the mean amount of liquid".
- Mean is the sum divided by the count.
- The sum is obtained by adding the values of all data points.

\[
\text{Sum} = \frac{1}{8} + \frac{1}{4} + \frac{1}{2} + \frac{1}{8} + \frac{1}{4} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8}
\]

\[
= \frac{27}{8}
\]

**There are 8 jugs, so the count is simply 8.**

**count = 8**
• Liquid in each jug

\[
\frac{\text{sum}}{\text{count}} = \frac{1}{\text{count}} \times \text{sum} = \frac{1}{8} \times \frac{27}{8} = \frac{27}{64}
\]

Type \( \frac{27}{64} \)

(or) 0.421875
## 6.SP.2 Skill Documentation

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Templates Used: All

### THE MASTERY SET (Spread of Line Plots)

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Templates Used: 331255, 337298, 337299

### THE MASTERY SET (Gaps in Line Plots)

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Templates Used: 331304, 337295, 337296, 337297
THE MASTERY SET (Comparison of Line Plots)

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Templates Used: 331217, 337302
There are 9 line plots with cluster of high data values for A and 9 line plots without cluster of high data values for B.

There are 9 titles for A and 9 titles for B.

The answer will always be “The data values in ‘A’ are generally higher.”
Choose the answer that describes the two line plots shown below.

- There are 9 line plots without cluster of high data values for A and 9 line plots with cluster of high data values for B.
- There are 9 titles for A and 9 titles for B.
- The answer will always be “The data values in ‘B’ are generally higher.”
There are 9 line plots for A and 9 line plots for B. The plots for A have a larger range.
There are 9 titles for A and 9 titles for B.
The answer will always be “A has a larger range than B.”
There are 9 line plots for A and 9 line plots for B. The plots for B have a larger range.

There are 9 titles for A and 9 titles for B.

The answer will always be “B has a larger range than A.”
There are 9 line plots for A and 9 line plots for B. The plots have the same range.

There are 9 titles for A and 9 titles for B.

The answer will always be “A and B have the same range.”
Choose the answer that describes the two line plots shown below:

A) Number of Ties

B) Number of Jackets

Select one:
- Only A has gap(s).
- Only B has gap(s).
- Neither has a gap.
- Both have gaps.

- There are 9 line plots for A and 9 line plots for B. The plots for A have gaps.
- There are 9 titles for A and 9 titles for B.
- The answer will always be “Only A has gap(s).”
There are 9 line plots for A and 9 line plots for B. The plots for B have gaps.

There are 9 titles for A and 9 titles for B.

The answer will always be “Only B has gap(s).”
There are 9 line plots for A and 9 line plots for B. The plots for both A and B have gaps.
There are 9 titles for A and 9 titles for B.
The answer will always be “Both have gaps.”
Choose the answer that describes the two line plots shown below:

A) Number of Sandals

B) Number of Sneakers

- There are 9 line plots for A and 9 line plots for B. All the plots don’t have a gap.
- There are 9 titles for A and 9 titles for B.
- The answer will always be “Neither has a gap.”
1) Assistment #344372 "344372 - 57849 - Spread of Line Plots (A)"
Choose the answer that describes the two line plots shown below.

**Multiple choice:**
- ❌ 'A' and 'B' have the same range.
- ❌ 'B' has a larger range than 'A'.
- ✓ 'A' has a larger range than 'B'.

**Hints:**
- The range of a line plot is the difference between the maximum and minimum values represented by the data points.
- The following example demonstrates the determination of the range of a line plot.

\[ \text{Range} = 5 - 0 = 5 \]
- The answer is
- 'A' has a larger range than 'B'.

---

**A) Number of Sandals**

**B) Number of Sneakers**
Choose the answer that describes the two line plots shown below:

A) Number of Pencils

B) Number of Pens

Multiple choice:
- ✗ Both have gaps.
- ✗ Neither has a gap.
- ✗ Only A has gap(s).
- ✓ Only B has gap(s).

Hints:
• A **gap** is a **space between data points** on a line plot.
• As an example, a **gap** is identified in the line plot shown below.

• The answer is
**Only B has gap(s).**
3) Assignment #344433 "344433 - 57849 - Comparison of Line Plots (A)"
Choose the answer that describes the two line plots shown below.

A) Number of Hours Spent Studying on Weekend

B) Number of Hours Spent Exercising on Weekend

Multiple choice:
× The data values in 'A' and 'B' are about the same.
× The data values in 'B' are generally higher.
✓ The data values in 'A' are generally higher.

Hints:
• The line plot with higher scores will have more data points clustered around high score values (the rightmost side of the plot).
• A cluster of high score values is identified in the following line plot as an example.

• The answer is

The data values in 'A' are generally higher.
### Appendix B.4.1: 6.SP.3 Skill Documentation

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Templates Used: All

#### THE MASTERY SET (Range of Line Plots)

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Templates Used: 334206, 335987

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Templates Used: 334250, 338607, 338654, 338663
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Templates Used: 343012, 345673

## THE MASTERY SET (Mean of Line Plots)

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Templates Used: 338745
Julie's scores in 8 history tests are shown in the line plot below. What is the range of Julie's scores?

Type your answer below (mathematical expression):
Smith's scores in 12 math tests are shown in the line plot below. What is the range of Smith's scores?

Type your answer below (mathematical expression):

- There are 5 line plots (all with 5 data values) for this template.
- The data values are variabilized.
- The name of the student and the subject are also variabilized.
The line plot below represents the number of purchases at eight toy shops. Determine the mode.

Type your answer below (mathematical expression):

- There are 5 line plots (all with 4 data values) for this template.
- The data values are variabilized.
- The type of store is also variabilized.
- The answer will always be the second data value from the left.
There are 5 line plots (all with 4 data values) for this template.
The data values are variabilized.
The type of store is also variabilized.
The answer will always be the rightmost data value.
There are 5 line plots (all with 5 data values) for this template.
- The data values are variabilized.
- The type of store is also variabilized.
- The answer will always be the second data value from the right.
The line plot below represents the number of credit card transactions at twelve grocery stores. Determine the mode.

There are 5 line plots (all with 5 data values) for this template.
The data values are variabilized.
The type of store is also variabilized.
The answer will always be the second data value from the left.
The line plot below shows the number of points Julie scored in the last 12 volleyball games. What is the median number of points scored by Julie?

There are 10 line plots (all with even number of data points) for this template.
The data values are variabilized.
The person name and the game are also variabilized.
The line plot below shows the number of points Kevin scored for the rugby games in the last 3 months. What is the median number of points scored by Kevin?

Type your answer below (mathematical expression):

- There are 10 line plots (all with odd number of data points) for this template.
- The data values are variabilized.
- The person name and the game are also variabilized.
A survey is taken on a group of students about their weekly soda consumption, and the responses are shown in the line plot below. What is the mean number of sodas consumed per week?

Note: Give the answer in fraction form.

Type your answer below (mathematical expression):

- There are 6 line plots for this template.
- The data values are variabilized.
- The type of food is also variabilized.
Appendix B.4.2: 6.SP.3 Skill Sample Problem Print

1) Assistance #365980 "365980 - 57508 - Mode of Line Plots (Algebra - 4 values) T2"

The line plot below represents the number of customers at eight pharmacies. Determine the mode.

![Line plot with data points at 24, 32, 40, and 46]

**Algebra:**

\[ 46 \]

**Hints:**

- The **mode** is the number that occurs most frequently in a set of numbers.
- On a line plot, the **mode** will have the highest stack of data marks.

An example is demonstrated below.

![Example line plot with data points at 21, 33, 37, and 42]

From this example plot, you can see that the highest stack of marks is at 33. There are more marks at 33 than in any other place. So 33 is the mode.

- For the given problem, the mode is 46.

Type **46**
2) Assistment #365997 "365997 - 57508 - Mean of Line Plots (Algebra)"
A survey is taken on a group of students about their weekly hotdog consumption, and the responses are shown in the line plot below. What is the mean number of hotdogs consumed per week?

\[ \text{sum} = (2 \times 2) + (4 \times 2) + (9 \times 1) + (10 \times 3) + (13 \times 1) = 64 \]
\[ \text{count} = 9 \]
\[ \text{mean} = \frac{\text{sum}}{\text{count}} = \frac{64}{9} \]

Note: Give the answer in fraction form.

Algebra:
\[ \checkmark 7.11111111111111 \]

Hints:
• Mean is the average of a set of numbers.
To calculate the mean, we add up all the numbers, and then divide by how many numbers there are.
• Mean is the sum divided by the count.

Type \( \frac{64}{9} \)
3) Assignment #366032 "366032 - 57508 - Range of Line Plots (Algebra - 5 values)"

Julie's scores in 12 history tests are shown in the line plot below. What is the range of Julie's scores?

![Line plot showing Julie's scores]

**Algebra:**

- **32**

**Hints:**

- The **range** is the difference between the maximum value and the minimum value of the set of data points.
- The **maximum** value is 55, and
- The **minimum** value is 23.

- The range is the difference between 55 and 23.
  
  \[55 - 23 = 32\]
  
  Type **32**
The line plot below shows the number of points Julie scored for the rugby games in the last 3 months. What is the median number of points scored by Julie?

For this problem, there are 13 data points and median is the 7th data point, circled on the line plot.

- median = 45
Type 45
Appendix D: Powerpoint Advertisement for Study

Slide1

New Skill Builder Content with motivational videos for measuring volume, area, and perimeter. Understanding and interpreting statistical data content. Help us learn if motivational videos affect learning. Half the students get motivational videos and hints, while the other half just get hints.

4.MD.3 Area and Perimeter
4.MD.4 Interpreting Statistical Data (Addition and Subtraction using Fraction)
5.MD.2 Interpreting Statistical Data (Fraction)
5.MD.3 Volume of Rectangular Prism
5.MD.5c Adding Volume of Rectangular Prisms
6.SP.1 Recognizing Statistical Questions
6.SP.2 Understanding Statistical Data
6.SP.3 Interpreting Statistical Data

To learn what to do next, click here

If you have any questions e-mail assistments@wpi.edu

Slide2

These are the videos your students will see if they are selected at random to get motivational videos. They see one when they start and then they also see videos when they get a problem wrong.
Slide 3

4.MD.3  Area and Perimeter
Skill Builder (work until 3 right in a row) - 91607

Slide 4

4.MD.4  Interpreting Statistical Data (Addition and Subtraction using Fraction)
5.MD.2  Interpreting Statistical Data (Fraction)
Skill Builder Problem Set - 91600

The following line plot shows the amount of orange juice in liters in 8 jugs. How much liquid will each jug contain if distributed equally?

Amount of Orange Juice (in liters)

5.MD.3  Volume of Rectangular Prism
Skill Builder Problem Set - 84903

A small cube has length 1, width 1, and height 1. How many small cubes would fit in the following box of length 2, width 2, and height 2?
5.MD.5c  Adding Volume of Rectangular Prism Skill
Builder Problem Set - 91602

6.SP.1  Recognizing Statistical Questions
Skill Builder Problem Set - 91599
6.SP.2  Understanding Statistical Data
Skill Builder Problem Set - 91605

6.SP.3  Interpreting Statistical Data
Skill Builder Problem Set - 91601
Your Next Steps

1. Find the content you would like to give to your students.
2. Assign one, some, or all of the problem sets. Because of the videos this is best for homework or if students have earphones in school.
3. Students will work until they get three right in a row and there is tutoring so you can look at the data or just monitor that students have finished.

The problem set can also be found in Assistments Certified Problem Set. see image below: