25 Oct 2004

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Recommended Citation
Hall, R. H., Hubing, N., Philpot, T. A., Flori, R. E., & Yellamraju, V. (2004). Assessment of Engineering Mechanics Instructional Multimedia in a Variety of Instructional Settings. *ASEE Annual Conference Proceedings*, pp. 881-897. ASEE PEER.
The definitive version is available at https://doi.org/10.18260/1-2--13148

Assessment of Engineering Mechanics Instructional Multimedia in a Variety of Instructional Settings

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1 Abstract

Students from ten schools, representing seven countries, used interactive multimedia as a part of their engineering statics classes. The software consisted of four modules, which focused on: Mohr's Circle; Centroid and Moment of Inertia; Stress Transformation; and Structural Analysis. The students completed on-line surveys about their experience with the software. Analysis of the results indicated that students rated their knowledge of the subject matter covered in the software as increasing significantly as a consequence of using the software. However, this increase was substantially more pronounced for students in U.S. schools. Students rated the software as significantly more effective than their class textbooks, and, again, this effect was substantially stronger for students in the U.S. The analyses also indicated that the software differed little in its impact on males versus females. Ratings on a number of additional outcomes were consistently positive with respect to student opinions of the software.

2 Introduction

Statics plays a foundational role in engineering education for many engineering disciplines. The subject builds on calculus and physics concepts involving vectors, systems of equations, equilibrium and integration, in order to solve new problems involving structures. The primary challenge to the statics instructor is to teach the correct application of just a few theoretical concepts. Hence, statics instructors tend to use many example problems to demonstrate the correct application of the theory. Difficulties involving time limitations and problems with visualization can arise when example problems require detailed drawings in order to convey the example properly. For this reason, classes in Statics are prime candidates as courses to be enhanced via multimedia learning tools [1, 2].

In order to address these instructional challenges, a group at the University of Missouri – Rolla has developed a series of multimedia modules, as part of a large scale multi-year project to introduce media-enhanced active learning into foundational classes in engineering [2-6]. Research thus far has indicated that these modules can be used to enhance instruction in a number of ways. They can be effective as an adjunct to class in the form of homework [7], or even as a substitute for the textbook or lecture [8]. However, all of the previous assessment has been conducted with students from the University of Missouri – Rolla. The purpose of this study was to extend this research by examining the effect of the software in a number of instructional settings, representing different types of universities and different cultural contexts.

3 Methodology

3.1 Population

Professors from a number of U.S. and international colleges and universities were contacted and offered an opportunity to access four different Interactive Multimedia Modules covering subjects in Statics during the Fall of 2003. Each of the modules was associated with an online survey. The professors were told that they could integrate the modules into their classes in any way they chose, and were requested to encourage students to complete surveys over the modules that they used.

Students of nineteen different faculty responded to the survey, representing sixteen different schools. Ten of the schools were located in the U.S. and ten were located outside of the U.S. The number of students who responded by school, module, and gender are presented in Table 1.

Table 1. Survey Responses as a Function of School, Module, and Gender

Location	School	MC		CMI		ST		SA		Tot
		M	F	M	F	M	F	M	F	
US	GTU[a]	12	7	--	--	9	3	--	--	31
	GTU[b]	5	1	--	--	9	2	--	--	17
	TT	7	0	3	0	5	1	--	--	16
	VWCC	1	0	3	0	3	0	--	--	7
	MCCC	0	2	7	1	2	0	--	--	12
	OSU[a]	--	--	43	4	--	--	--	--	47
	OSU[b]	--	--	33	7	--	--	--	--	40
	PSCC	--	--	--	--	--	--	17	2	19
	PSU	--	--	--	--	--	--	1	0	1
	RU	--	--	--	--	--	--	21	2	23
	UMR	--	--	--	--	--	--	38	7	45
	USAF	--	--	--	--	--	--	36	7	43
International	TDM[a]	1	0	3	0	4	0	--	--	8
	WIT	1	0	--	--	--	--	--	--	1
	ITA	19	10	18	11	26	7	--	--	91
	TDM[b]	1	0	0	1	--	--	--	--	2
	SU	--	--	8	0	--	--	--	--	8
	ITE	--	--	--	--	--	--	29	20	49
	UWE	--	--	--	--	--	--	22	0	22
Total		47	20	118	24	58	13	164	38	460

MC=Mohr's Circle; CMI=Centroid and Moment of Inertia; ST=Stress transformation, SA= Structural analysis
GTU, Georgia Tech University, Atlanta, Georgia; TT, Texas Tech University, Lubbock, Texas; VWCC, Virginia Western Community College, Roanoke, Virginia; MCCC, Monroe County Community College, Monroe, Michigan; OSU, Ohio State University, Columbus, Ohio; PSCC, Pellissippi State Technical Community College, Knoxville, Tennessee; PSU, Penn State University, University Park, Pennsylvania; RU, Rowan University, Glassboro, New Jersey; UMR, University of Missouri – Rolla, Rolla, Missouri; USAF, United States Air Force Academy, Colorado Springs, Colorado; TDM, Tec de Monterrey, Monterrey Mexico; WIT, Waikato Institute of Technology, New Zealand; ITA, Instituto da Technologia da Amazonia, Brazil; SU, University of Sarajevo, Zenica, Bosnia and Herzegovinia; ITE, Institute of Technical Education, Singapore; UWE, University of West of England
[a, b, …] represent different instructors at the same school

3.2 Modules

The modules covered four subjects: Mohr's Circle; Centroid and Moment of Inertia; Stress Transformation; and Structural Analysis. Example screen shots and a web address for each module are shown in Figures 1 through 4.

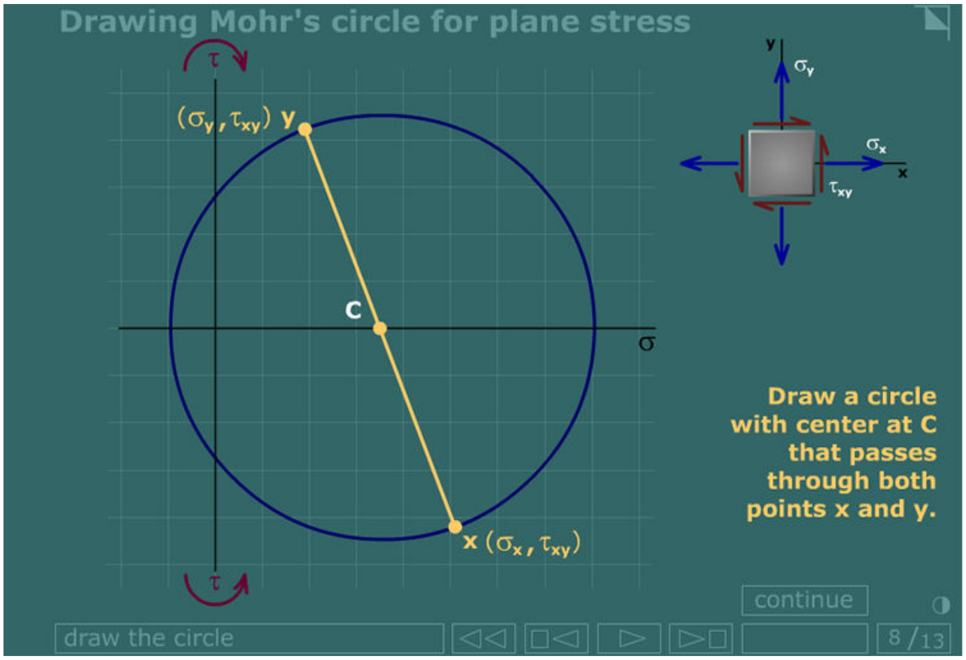

Figure 1. Screen Shot from Mohr's Circle Module.
(*http://web.umr.edu/~bestmech/stress.htm*)

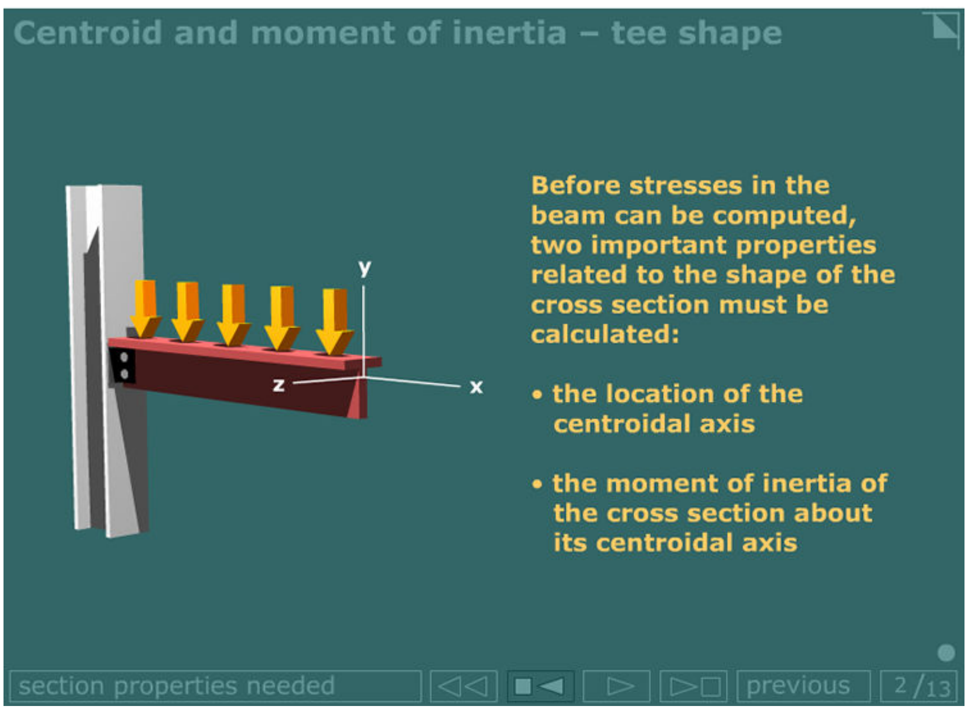

Figure 2. Screen Shot from Centroid and Moment of Inertia Module
(*http://web.umr.edu/~bestmech/sectprop.htm*)

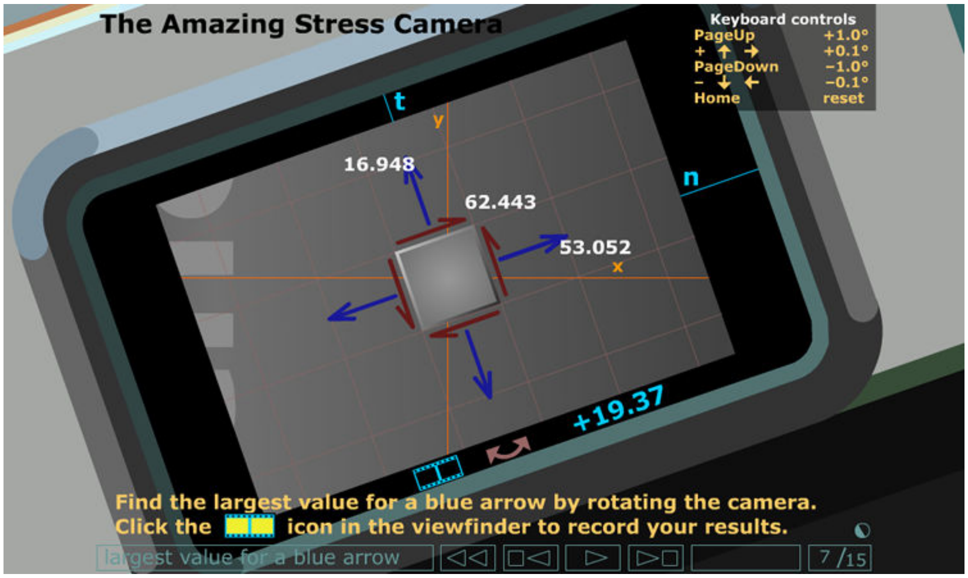

Figure 3. Screen Shot from Stress Transformation Module
(*http://web.umr.edu/~bestmech/stress.htm*)

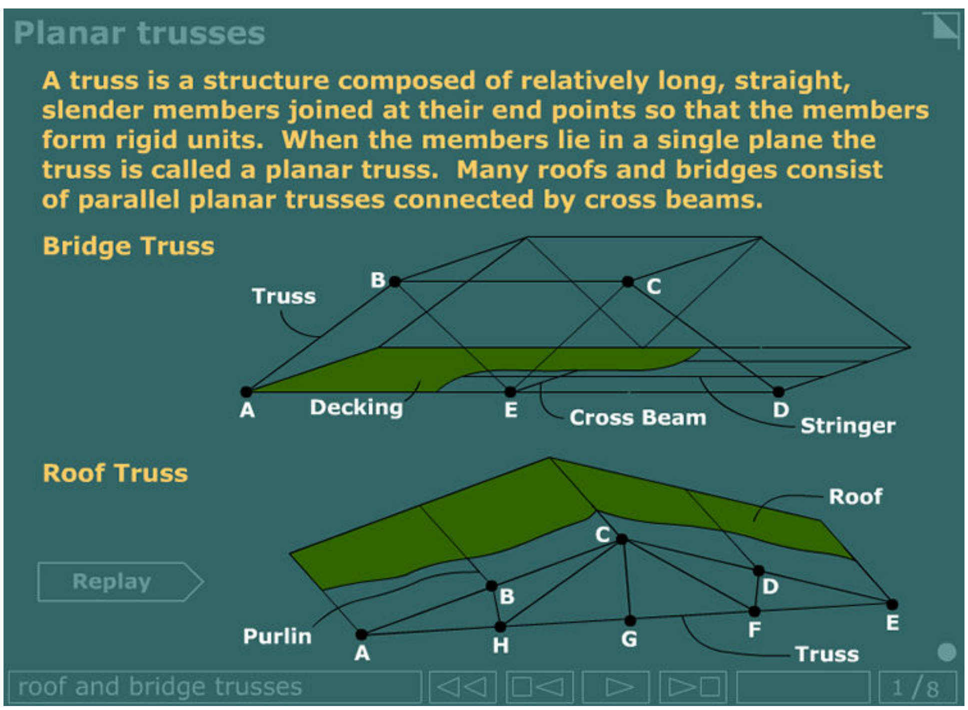

Figure 4. Screen Shot from Structural Analysis Module
(*http://web.umr.edu/~bestmech/statics_sa.html*)

4 Results

4.1 Comparison of Pre vs. Post Knowledge Ratings

4.1.1 Survey Questions

The surveys for the "Mohr's Circle" and "Centroid and Moment of Inertia" modules, each included a series of six questions, which asked students to rate their knowledge on an important aspect of the topic covered in the module before and after they completed the module. On each of these questions students were asked to rate their degree of agreement from 1 to 9, with 1 representing "strongly disagree" and 9 representing "strongly agree".

The six questions for the Mohr's Circle module were:

(1) **Before** using the Mohr's circle collection, I was confident in my ability to properly construct Mohr's circle for a specific set of stresses acting in the x and y directions.
(2) **After** using the Mohr's circle collection, I was confident in my ability to properly construct Mohr's circle for a specific set of stresses acting in the x and y directions.
(3) **Before** using the Mohr's circle collection, I was confident in my ability to determine principal stress magnitudes and orientation using Mohr's circle.
(4) **After** using the Mohr's circle collection, I was confident in my ability to determine principal stress magnitudes and orientation using Mohr's circle.
(5) **Before** using the Mohr's circle collection, I was confident in my ability to determine the normal stress and shear stress acting on a specified plane using Mohr's circle.
(6) **After** using the Mohr's circle collection, I was confident in my ability to determine the normal stress and shear stress acting on a specified plane using Mohr's circle.

The six questions for the Centroid and Moment of Inertia module were:

(1) **Before** using the centroid and moment of inertia review, I was confident in my ability to determine the centroid location for composite shapes such as those shown below.
(2) **After** using the centroid and moment of inertia review, I was confident in my ability to determine the centroid location for composite shapes such as those shown below.
(3) **Before** using the centroid and moment of inertia review, I was confident that I could correctly determine the moments of inertia (about both the horizontal and vertical centroidal axes) for shapes such as those shown above.
(4) **After** using the centroid and moment of inertia review, I was confident that I could correctly determine the moments of inertia (about both the horizontal and vertical centroidal axes) for shapes such as those shown above.
(5) **Before** using the centroid and moment of inertia review, I was confident that I could correctly determine the moments of inertia (about both the horizontal and vertical centroidal axes) for shapes consisting of standard steel shapes.
(6) **After** using the centroid and moment of inertia review, I was confident that I could correctly determine the moments of inertia (about both the horizontal and vertical centroidal axes) for shapes consisting of standard steel shapes.

A "before" and "after" composite score was created for both surveys, by averaging the responses to the three before and three after questions respectively.

4.1.2 U.S. vs. International Schools

4.1.2.1 Analysis

In order to examine the effect of location (U.S. vs. International) a location variable was created, with students from U.S. schools classified as U.S. and students from schools outside the U.S. classified as international. For both the Mohr's Circle and Centroid and Moment of Inertia Modules a two-way mixed analysis of variance (ANOVA) was computed with Time (before vs. after) serving as a within-subject independent variable, Location (U.S. vs. International) serving as a between-subject independent variable, and ratings serving as the dependent variable.

In the Mohr's circle analysis significant effects were found for Time $F(1,58) = 32.88$, $p < .001$; Location $F(1,58) = 28.97$, $p < .001$, and the Time X Location interaction $F(1,58) = 29.49$, $p < .001$. Similarly, all three effects were significant in the Centroid and Moment of Inertia ANOVA: Time $F(1,132) = 90.17$, $p < .001$; Location $F(1,132) = 12.36$, $p < .01$; and Time X Location $F(1,132) = 21.52$, $p < .001$. Figures 5 and 6 display the means associated with these two ANOVAs.

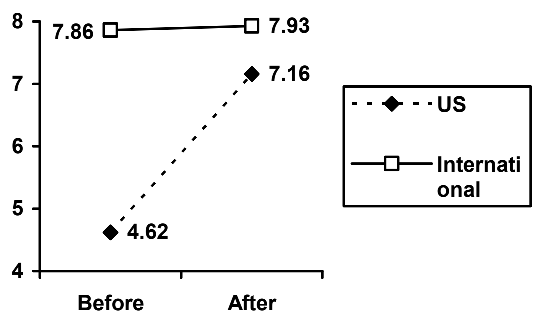

Figure 5. Ratings as a Function of Time and Location for the Mohr's Circle Questionnaire.

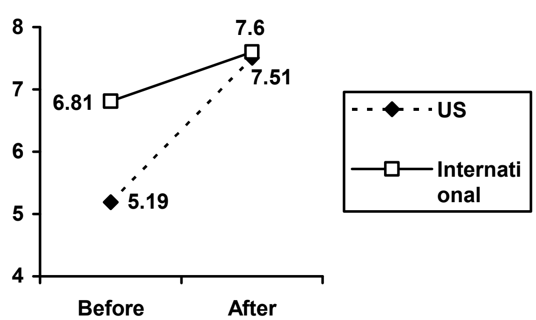

Figure 6. Ratings as a Function of Time and Location for the Centroid and Moment of Inertia Questionnaire.

4.1.2.2 Interpretation

The significant main effects for Time and Location indicate that, overall: 1) students rated their knowledge after using the software as significantly higher than before and 2) the international students rated their knowledge of the topics higher. However, both of these main effects are better explained by the significant interactions. In both cases, the international students rated their knowledge before as being substantially greater than the U.S. students, but this gap was, for the most part, closed in the after-software rating. As a consequence, the large pre to post rating gain was mainly the result of the U.S. students' increase, while the increase was not so dramatic for the international students.

This effect may be interpreted in a number of ways. The most obvious, is that the U.S. students benefited more from the software. It is also possible that the high initial ratings for the international students simply left little room for improvement on the post ratings. It's also possible that the U.S. students are simply less confident initially, and become more confident as a result of their experience with the software. In summary, the ratings increased significantly across groups, but the effect was exhibited much more dramatically with the U.S. students.

4.1.3 Males vs. Females

4.1.3.1 Analysis

Change in pre to post test rating was also examined as a function of gender in two mixed analyses of variance (ANOVAs), one for both the Mohr's Circle and Centroid and Moment of Inertia surveys. Time (before vs. after) again served as a within-subject independent variable, Gender (male vs. female) served as a between-subject independent variable, and ratings served as the dependent variable. In reporting the results below we will not discuss the main effect for Time, since that effect is redundant with respect to the previous ANOVAs.

In the Mohr's circle ANOVA no non-redundant significant effects were found. That is, there was not a significant main effect for Gender, or a significant Gender X Time interaction.

In the Centroid and Moment of Inertia Analysis there was also no significant main effect for Gender, but there was a significant Gender X Time interaction, $F(1,132) = 6.26$, $p < .05$. The means associated with this interaction are displayed in Figure 7.

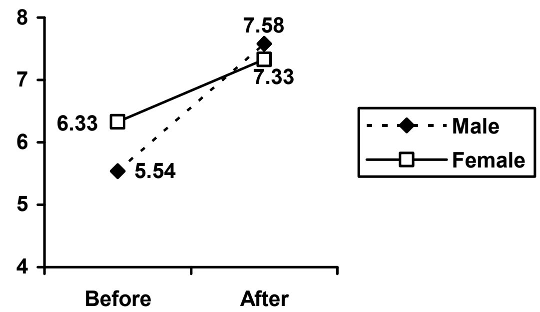

Figure 7. Ratings as a Function of Time and Gender for the Centroid and Moment of Inertia Questionnaire.

Interpretation

The significant interaction that was found in the Centroid and Moment of Inertia analysis indicates that, while both males and females increased in their rating, the increase was greater for the males. They initially rated their knowledge lower, and subsequently rated their knowledge slightly higher, following their experience with the software. This indicates that, to the extent that the positive impact of the software differed as a function of gender, this impact was greater for males. However, it's important to note that ratings increased for both males and females. Moreover, three of the four possible effects involving gender in this set of ANOVAs were not significant; so overall, these results did not indicate that gender had a consistent and significant effect on change in knowledge associated with the software.

4.2 Comparison of Software with Class Text Book

4.2.1 Survey Questions

Each of the four surveys included the following two items:

(1) Give your overall evaluation of the *(insert module topic)* using the 1…..9 scale, with 1 being very poor and 9 being outstanding.
(2) For comparison, give your overall evaluation of your TEXTBOOK'S coverage of *(insert module topic)*, using the 1…..9 scale, with 1 being very poor and 9 being outstanding.

These items were used for the analysis of the comparison of the multimedia software with the text, which follows.

4.2.2 U.S. vs. International Schools

4.2.2.1 Analysis

In order to examine the effect of location (international vs. U.S.) on software vs. text book comparisons a series of four mixed analyses of variance (ANOVAs) were computed, one for each of the four surveys. In each ANOVA, Medium (software vs. text) was a within-subject independent variable, Location (U.S. vs. International) was a between-subject independent variable, and ratings were the dependent variable.

In each of the four ANOVAs, all three possible effects were statistically significant. The statistics associated with these effects follow.

- Mohr's Circle: Medium $F(1,62) = 21.04$, $p < .001$; Location $F(1,62) = 19.62$, $p < .001$; Medium X Location $F(1,62) = 22.56$, $p < .001$.
- Centroid and Moment of Inertia: Medium $F(1,138) = 35.73$, $p < .001$; Location $F(1,138) = 21.76$, $p < .001$; and Medium X Location $F(1,138) = 10.58$, $p < .01$.
- Stress Transformation: Medium $F(1,66) = 21.05$, $p < .001$; Location $F(1,66) = 22.14$, $p < .001$; Medium X Location $F(1,66) = 10.63$, $p < .01$
- Structural Analysis: Medium $F(1,200) = 25.34$, $p < .001$; Location $F(1,200) = 16.77$, $p < .001$; Medium X Location $F(1,200) = 19.77$, $p < .001$

The means associated with these ANOVAs are presented in Figures 8 through 11.

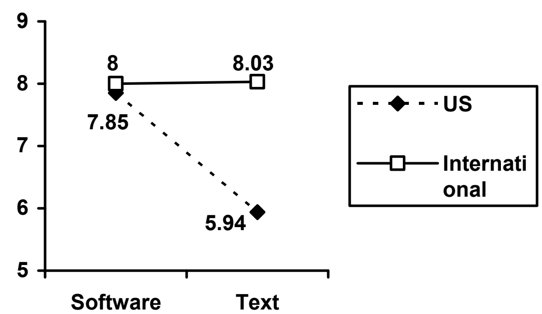

Figure 8. Overall Ratings as a Function of Medium and Location for the Mohr's Circle Questionnaire.

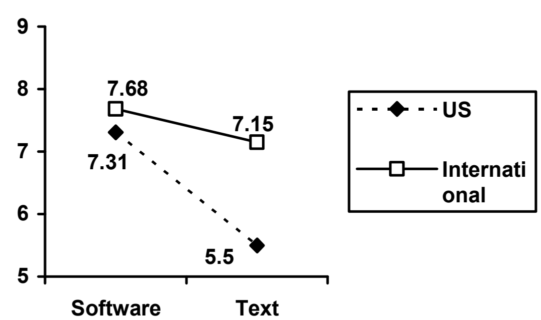

Figure 9. Overall Ratings as a Function of Medium and Location for the Centroid and Moment of Inertia Questionnaire.

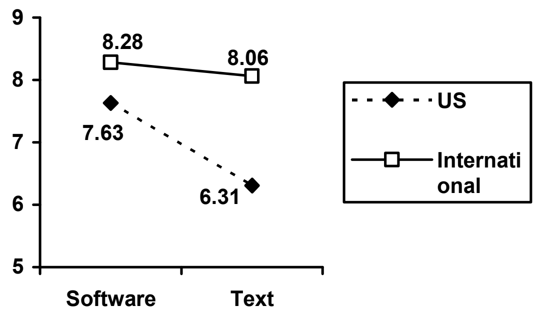

Figure 10. Overall Ratings as a Function of Medium and Location for the Stress Transformation Questionnaire.

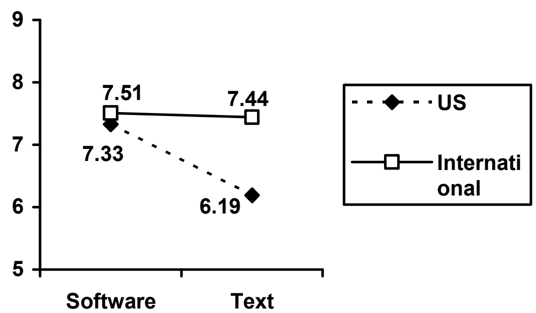

Figure 11. Overall Ratings as a Function of Medium and Location for the Structural Analysis Questionnaire.

4.2.2.2 Interpretation

The results of all four analyses are quite consistent. Significant main effects were found indicating that, overall, students rated the software higher than the text and, overall, the international students had higher ratings. As with the time analyses above, these main effects can be better explained by the significant interactions that were also found in each of the four ANOVAs. The substantially higher rating for the software is principally the result of the U.S. students across analyses. In fact, in the Mohr's circle questionnaire, the international students even rated the text and software almost identically, though in all other cases the international students rate the software higher. Another way to view these results is that the U.S. students simply rate their text books as worse for explaining this information than the international students, though, note that the scale ranged from 1 to 9, so the text ratings are all above the scale midpoint. These results, once again, indicate that the positive impact of the software is greatest for the U.S. students.

4.2.3 Males vs. Females

4.2.3.1 Analysis

In order to examine the role of gender in the ratings of the software vs. text, another series of four analyses of variance (ANOVAs) were computed, one for each of the surveys. As with the previous analyses, Medium (software vs. text) served as a within-subject independent variable, while, in these ANOVAs, Gender (Male vs. Female) served as a between-subject independent variable, and ratings served as the dependent variable.

As with the previous Gender ANOVAs, significant main effects for the non-gender independent variable (Medium) were not considered, since they are redundant with respect to the previous analyses. None of the Gender effects (Gender or Gender X Medium) were statistically significant in any of the four ANOVAs.

4.2.3.2 Interpretation

These results lend further and stronger support to the contention that gender did not have a significant effect on the impact of the software. However, these results should be interpreted with some caution due to the small sample size for females. There were substantially less females than males in each of survey sample (see Table 1). Though the analysis of variance is robust with respect to differences in sample sizes, the small number of women in some of the surveys may not provide a very representative and robust sample.

4.3 Additional Outcomes

4.3.1 Analysis

In addition to items about pre vs. post knowledge and/or software vs. text, each of the four surveys included a number of additional items that did not allow for a direct inferential statistical comparison representing the software's effectiveness. These questions were included in order to get some indication of students overall attitudes about the software. The means can, however, be considered with respect to the scale midpoint (i.e., 4.5), keeping in mind that all questions were on a 9 point scale with 1 representing "strongly disagree" and 9 representing "strongly agree". The additional questions that were included in each of the four surveys and the mean responses are displayed in tables 2 – 5.

Table 2. Mean responses on Additional Mohr's Circle Survey Items
(1 represents "strongly disagree" and 9 represents "strongly agree")

Question		Mean
1	I learned a great deal of information from the Mohr's circle collection (referring to the group of theory movies, examples, games, and animations) on the website.	7.75
2	I thought the pictures and animations in the Mohr's circle collection were much more effective in explaining this topic than the illustrations in my textbook.	8.09
3	I thought the interactive features of the Mohr's circle collection (such as Concept Checkpoints, instant feedback, and games) were very helpful and effective learning aids.	8.02
4	The Mohr's circle collection helped me clearly identify the things I know well and the things I need to work on concerning Mohr's circle for plane stress.	7.82
5	Learning about this topic with the Mohr's circle collection was more interesting than the typical classroom-and-textbook routine. (Please comment on any portions that were particularly pleasing to you.)	7.83
6	The time I spent on the Mohr's circle collection was a worthwhile use of my study time.	8.00
7	I would voluntarily use the Mohr's circle collection for learning even if I were not required to do so by my instructor.	7.51
8	The Mohr's circle collection was easy to navigate and easy to use.	8.14
9	The technical features of the Mohr's circle collection worked well (without software malfunctions or Internet connection difficulties).	8.34

Table 3. Mean responses on Additional Centroid and Moment of Inertia Survey Items
(1 represents "strongly disagree" and 9 represents "strongly agree")

Question		Mean
1.	I learned a great deal of information from the centroid and moment of inertia review (referring to the group of games and examples) on the website.	7.15
2.	I thought the pictures and animations in the centroid and moment of inertia review were much more effective in explaining this topic than the illustrations in my textbook.	7.53
3.	I thought the interactive features of the centroid and moment of inertia review (such as Concept Checkpoints, instant feedback, and games) were very helpful and effective learning aids.	7.59
4.	The centroid and moment of inertia review helped me clearly identify the things I know well and the things I need to work on concerning this topic.	7.35
5.	Learning about this topic with the centroid and moment of inertia review was more interesting than the typical classroom-and-textbook routine. (Please comment on any portions that were particularly pleasing to you.)	7.18
6.	The time I spent on the centroid and moment of inertia review was a worthwhile use of my study time.	6.95
7.	I would voluntarily use the centroid and moment of inertia review for learning even if I were not required to do so by my instructor.	6.29
8.	The centroid and moment of inertia review was easy to navigate and easy to use.	7.86
9.	The technical features of the centroid and moment of inertia review worked well (without software malfunctions or Internet connection difficulties).	7.86

Table 4. Mean responses on Additional Stress Transformation Survey Items (1 represents "strongly disagree" and 9 represents "strongly agree")

Question	Mean
1. I learned a great deal of information from the stress transformation collection (referring to the group of theory movies, examples, games, and animations) on the website.	7.50
2. The stress transformation collection helped me understand calculation procedures and sign conventions for stress transformation problems.	7.90
3. The stress transformation collection helped me understand how to calculate the normal stress and shear stress acting on a specified plane.	7.84
4. I thought the pictures and animations in the stress transformation collection were much more effective in explaining this topic than the illustrations in my textbook.	7.96
5. I thought the interactive features of the stress transformation collection (such as Concept Checkpoints, instant feedback, and games) were very helpful and effective learning aids.	7.84
6. The stress transformation collection helped me clearly identify the things I know well and the things I need to work on concerning stress transformations.	7.67
7. Learning about this topic with the stress transformation collection was more interesting than the typical classroom-and-textbook routine. (Please comment on any portions that were particularly pleasing to you.)	7.64
8. The stress transformation collection helped me relate stress transformation concepts to "real world" engineering applications where these concepts might be used.	7.52
9. The time I spent on the stress transformation collection was a worthwhile use of my study time.	7.72
10. I would voluntarily use the stress transformation collection for learning even if I were not required to do so by my instructor.	7.54
11. The stress transformation collection was easy to navigate and easy to use.	7.94
12. The technical features of the stress transformation collection worked well (without software malfunctions or Internet connection difficulties).	8.07

Table 5. Mean responses on Additional Structural Analysis Survey Items (1 represents "strongly disagree" and 9 represents "strongly agree")

Question	Mean
1. I learned a great deal of information from the structural analysis theory, examples and problems on the website.	6.98
2. I found that the structural analysis material helped me to better visualize truss and frame problems.	7.55
3. I found that the structural analysis material helped me to better understand solution methods for TRUSS problems.	6.98
4. I found that the structural analysis material helped me to better understand solution methods for FRAME problems.	6.79
5. The structural analysis material helped me to recognize how much I know and don't know about trusses and frames.	7.26
6. I found that the structural analysis material on trusses and frames to be motivational.	6.35
7. The structural analysis material helped me to understand "real world" engineering applications for trusses and frames.	7.06
8. The time I spent on the structural analysis modules was a worthwhile use of my time.	7.34
9. The procedure for using the structural analysis modules was easy to understand.	7.43
10. The program for the online structural analysis material worked as it should, without technical difficulties.	7.59

4.3.1.1 Interpretation

Across all four questionnaires the responses are consistently positive, considering the scale midpoint of 4.5. The students consistently gave very high ratings to questions indicting they: a) learned a great deal; b) were better able to visualize complex concepts; c) were made more aware of their existing knowledge; d) were better able to apply their knowledge; e) felt the experience was worthwhile; and f) even reported that they would use these modules for even if they weren't required for class.

5 Conclusions

5.1 Summary and Interpretation

Considered as a whole, these survey results provide strong support for the effectiveness of this instructional multimedia. This support was almost as strong as it could be given the subjective questionnaires that were used. Students consistently rated their knowledge as greater after using the software than before, consistently rated the software better than the text, and demonstrated strong agreement with a number of other statements indicating the effectiveness of the software. Further, these effects were largely consistent across males and females, in that all but one of the analyses that considered gender did not yield statistically significant effects.

There is, however, one important twist. The positive impact was manifested much more for students from U.S., as opposed to non-U.S., institutions. Although in virtually every case that location (U.S. vs. international) was considered, both groups gave more positive ratings for the software, the positive effect was much more pronounced for the U.S. students. There are a number of reasons that such an effect would occur, most of which center around the fact that the software was created at the University of Missouri – Rolla, a U.S. University. In fact, all of the content and most of the software design was provided by professors who were born and raised in the United States. All of the written information in the software was in English written by these faculty, and for many of the students in the international universities this was most likely not their first language. This may have been particularly relevant in comparing the software and text books, where the text may not have been written in English. Beyond language, there may also be cultural difference in the way that students in U.S. vs. non-U.S. schools view and most effectively learn engineering concepts.

5.2 Dissemination Plan

As mentioned previously, this project was sponsored by the United States Department of Education, and initial dissemination and integration of the software was an anticipated outcome of the project. We have packaged the mechanical of materials software into a group of modules we refer to as *MecMovies*. Based on the results of studies such as these (see Hall et al. [9] for a comprehensive review of the project assessment) we believe that the *MecMovies* package is poised to make a significant impact on Mechanics of Materials education within the next two years. The software has been presented in talks to engineering mechanics educators at the past two American Society for Engineering Education (ASEE) Annual Conferences, and it was enthusiastically received and highly praised at both meetings. At the 2002 Conference, a paper discussing *The Centroids Game* and *The Moment of Inertia Game* [10] was awarded a Best Presentation award. In the July 2004, *MecMovies* will be submitted in the NEEDS Premier Award competition. There have also been discussions with the textbook publisher John Wiley & Sons about including the software in the 6th Edition of the Riley, Sturges, and Morris textbook, tentatively set for release in Fall 2005. The project developers have also been approached by Wiley about developing a new type of textbook developed specifically to utilize MecMovies.

6 Bibliography

[1]Rutz, E., R. Eckart, J. Wade, C. Maltbie, C. Rafter, and V. Elkins, *Student Preformance and Acceptance of Instructional Technology: Comparing Technology-Enhanced and Traditional Instruction for a Course in Statics.* Journal of Engineering Education, 2003. **92**: p. 133-140.

[2]Hubing, N., R. Flori, R.H. Hall, D.B. Oglesby, T.A. Philpot, and V. Yellamraju. *Interactive Learning Tools: Animating Statics*. in *American Society for Engineering Education Conference*. 2002. Montreal, CA.

[3]Philpot, T.A., R. Flori, R.H. Hall, N. Hubing, D.B. Oglesby, and V. Yellamraju. *Interactive learning Tools: Animating mechanics of materials*. in *American Society for Engineering Education Conference*. 2002. Montreal, Canada.

[4]Philpot, T.A., R.H. Hall, N. Hubing, R. Flori, D.B. Oglesby, and V. Yellamraju, *Animated instructional media for stress transformations in a mechanics of materials course.* Computer Applications in Engineering Education, 2003. **11**: p. 40-51.

[5]Hall, R.H., T.A. Philpot, D.B. Oglesby, R. Flori, N. Hubing, S.E. Watkins, and V. Yellamraju. *A model for the evaluation of innovative engineering courseware: Engineering an assessment program*. in *American Society for Engineering Education Conference*. 2002. Montreal, Canada.

[6]Flori, R.E., D.B. Oglesby, T.A. Philpot, N. Hubing, R.H. Hall, and V. Yellamraju. *Incorporating Web-Based Homework Problems in Engineering Dynamics*. in *American Society of Engineering Education Conference*. 2002. Montreal, CA.

[7]Philpot, T.A. and R.H. Hall, *The amazing stress camera: An interactive discovery experience.* Interactive Multimedia Electronic Journal of Computer Enhanced Learning, 2003. **5**: p. http://imej.wfu.edu/articles/2003/1/04.

[8]Philpot, T.A., N. Hubing, R.H. Hall, R. Flori, D.B. Oglesby, and V. Yellamraju. *Games as Teaching Tools in Engineering Mechanics Courses*. in *American Society of Engineering Education Conference*. 2003.

[9]Hall, R.H. *Guided surfing: Development and assessment of a world wide web interface for an undergraduate psychology class*. in *North American Web Conference*. 1997. Fredericton, New Brunswick, Canada.

[10]Philpot, T.A., R. Flori, R.H. Hall, N. Hubing, D.B. Oglesby, and V. Yellamraju, *Interactive Learning Tools: Animating Mechanics of Materials.* Proceedings of the American Society for Engineering Education, 2002: p. http://www.asee.org/conferences/caps/document2/2002-1527_Paper.pdf.

7 Acknowledgement

This work was supported in part by a grant from the United States Department of Education

Fund for the Improvement of Post-Secondary Education (FIPSE #P116B000100).

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