Daily Fundamentals – Your Daily Dose Of Mechanics Exercises

Joseph P. Hanus, Mark D. Evans, Mark Orwat
United States Military Academy

Abstract

The "Daily Dozen" is a traditional name given to a set of callisthenic exercises used in the United States Army. The exercises represent a daily dose of required physical training. A homework system recently introduced in a mechanics course at the United States Military Academy (USMA), West Point, New York, follows this military tradition in name and purpose. "Daily Fundamentals" were introduced to USMA's Statics and Dynamics course in the spring semester of 2000 as a homework system that challenged the students without overloading them or the instructors. The Daily Fundamentals were essentially short, multi-problem homework sets assigned after the majority of the course lessons. The features of the Daily Fundamentals included the problem statement with answers, a simplistic scoring system, and the recording of student time required to complete the problem.

The effect of the Daily Fundamentals on the students' academic performance was investigated to include an analysis of exam and final course grade averages, incoming versus outgoing grade point averages, and the results of the students' survey of the course learning objectives. Additionally, the results of time surveys administered throughout the course, Fundamental of Engineering (FE) Exam passing rates, and anecdotal comments from written critiques by students and instructors were all considered in the investigation of the effectiveness of the Daily Fundamentals. Overall, there was little evidence of a positive effect on the academic performance, but this was not the original goal of the Daily Fundamentals. Positive evidence was observed in the time survey, FE passing rates and written critiques that support the Daily Fundamentals as a tool that enhanced student learning and the improved efficiency of instructor assessments of their students.

I. Introduction

The "Daily Dozen" is a traditional name given to a set of calisthenics exercises used in the United States Army. The exercises represent a daily dose of required physical training to maintain a minimum standard of physical fitness. Homework modifications recently made in an engineering mechanics course at the United States Military Academy (USMA) at West Point, New York, follows this military tradition with its name and purpose. "Daily Fundamentals" were introduced in USMA's Statics and Dynamics course in the spring semester of 2000 as a modification to regular homework to challenge the students daily without overloading them or the instructors.

II. "Time-On-Task"

Similar to the Army's "Daily Dozen" the "Daily Fundamentals" were designed for the students to practice mechanics problems daily and thus remain proficient throughout the course. Daily Fundamentals were also introduced to increase student "time-on-task". "Engaged-time" or "time-on-task" refers to portions of time during which students are paying attention to a learning task and attempting to learn." (Cotton and Wikelund)[1]. Cotton and Wikelund [1] found that there was a "positive relationship between time-on-task and student achievement". Similar findings were reported by many researchers who have investigated such relationships: (Anderson [2, 3]; Borg [4]; Cotton and Savard [5]; Derevensky, Hart, and Farrell [6]; Fisher and Berliner [7]; Good and Beckerman [8]; Guskey and Gates [9]; Hossler, Stage, and Gallagher [10]; Karweit [11, 12, 13] ; Leach and Tunnecliffe [14]; Lomax and Cooley [15]; Mazzarella [16]; McGarity and Butts [17]; O'Donnell [18]; Quartarola [19]; Rosenshine [20]; and Sanford and Evertson [21]). Such findings should be cautiously interpreted, reports Cotton and Wikelund [1], as it appears that the effects of a given amount of "time-on-task" differ depending upon student characteristics, instructional strategies, and subject matter. They concluded that:

(1) "Time-on-task" in interactive activities with a teacher produces greater achievement and better attitudes than time on -task in seatwork (Cotton and Wikelund)[1]. Thus, while time spent on homework (the Daily Fundamentals described in this paper) is effective, such homework time is not as effective as time-on-task in the classroom, while engaged with the teacher.

(2) Increasing allocated or engaged time is more beneficial to lower-ability students than to higher-ability students (Cotton and Wikelund)[1]. It stands to reason that only the students who need the additional reinforcement and practice will benefit from it. In fact, the writers of this paper observe that too much "time-on-task" forced upon the student of higher ability can be a negative motivator. Students of higher ability may not improve at all by increased "time-on-task" (Anderson [22]; Brown and Saks [23]; Gettinger [24, 25]; Kidder, O'Reilly, and Kiesling [26]).

(3) Increasing "time-on-task" reduces the anxiety and enhances the achievement of highly anxious students (Cotton and Wikelund)[1]. It stands to reason that students who experience test anxiety, or students who have difficulty working in a timed environment, will benefit from frequent, repeated practice.

(4) **Increasing "time-on-task" is more beneficial in the more highly structured subjects, such as mathematics and foreign languages, than in the less structured ones, such as language arts and social studies** (Cotton and Wikelund)[1].

Armed with the information from the various studies cited above, Daily Fundamentals were introduced into Statics and Dynamics. It was recognized that not all students would benefit to the same degree, but that lower-level and intermediate ability students would see some benefit from the Daily Fundamentals. The following sections of this paper describe the course background, how the Daily Fundamentals were implemented, and how outcomes were assessed.

III. Statics And Dynamics Course Background

Statics and Dynamics, course number EM302 at USMA, is a three credit-hour engineering mechanics course that is offered both fall and spring semesters in the Civil and Mechanical Engineering Department. The course consists of three main blocks of traditional mechanics material: Statics, Kinematics and Kinetics. The course content includes two and three dimensional equilibrium applications (trusses, frames, cables, friction), kinematics analysis of two-dimensional bodies in general plane motion and two-dimensional kinetics methods (force-acceleration, impulse-momentum and work-energy). The course is required for all civil, mechanical and electrical engineering majors. It is an elective for several other engineering programs, to include systems and environmental engineering. Also, unique to the West Point academic system, non-engineering students may be required to take the course. All USMA students, regardless of their major, are required to complete a five-course sequence in an engineering field. EM302 is the first course in the majority of the engineering field sequences. EM302 is comprised mostly of non-engineering majors in the fall semester and engineering majors in the spring semester, with an enrollment of 200 to 300 students each semester.

IV. Statics And Dynamics Course Assessment

All courses are assessed annually, generally in the summer at the end of the spring semester. However, an interim assessment was performed during the fall semester of academic year 2000. The primary focus of the assessment was on the course graded requirements because they were central to the nature of the course in the study of the fundamentals of mechanics. The original course requirements during this assessment period consisted of ten multi-problem homework sets with each consisting of several separate problems, two special projects consisting of open ended problems, two partial period quizzes, three full period exams and a three and a half hour term end exam. Several assessment tools were used to evaluate the course in the fall semester of 1999. These tools included instructor course appraisals and student critiques in the form of in-class written critiques and out-of-class web-based feedback systems. Overall, the course has been a favorite among the students at USMA for its real-world applications, motivated and knowledgeable instructors, and well-organized course content. However, students expressed concern about the amount of time spent on the course requirements. Interestingly, a separate time survey administered each lesson during the semester showed an average of approximately one hour out-of-class time spent for each one hour of in-class time. This value is half of the desired two hours expected of students in engineering courses. Regardless of the actual time averages, the students considered the course requirements to be excessive. Additionally, instructors expressed equal distress about the amount of time spent grading homework assignments and exams. Clearly, there was a need to closely examine the course graded requirements.

A new set of course requirements was developed to met several goals:

1. Maintain the student and instructor's positive overall opinions of the course.
2. Change the number and type of course requirements such that the students' "time-on-task" increases, but their perceived workload does not increase.

3. Change the number and type of course requirements to address the instructors concerns about grading workload.
4. Challenge the students with course requirements that are exciting and focus on the real-world applications of engineering mechanics.

Several actions were taken to meet the four goals identified above. To ensure the course maintained the positive opinion of the students and instructors, an extensive assessment process was used to evaluate the changes in the course. It was intended to monitor that the proposed change did not negatively affect the following areas:

1. Students' academic performance to include course averages and incoming versus outgoing GPAs,
2. Students' self-assessment of their perceived competence in course objectives,
3. Students' out-of-class time spent on the course,
4. Students' performance on the National Fundamentals of Engineering (FE) Exam compared to national averages,
5. Students' end-of-course written and web-based critiques,
6. Instructor's end-of-course critiques.

Several options for changing the number and type of course requirements were considered for implementation in the spring semester of 2000. The final decision was to use five multi-problem homework sets, three full-period exams, and the same term end exam. Several partial-period quizzes were eliminated. The special projects-related homework assignments were eliminated as a separate course requirement and were incorporated into the normal multi-problem homework sets. The five multi-problem homework sets would be spread throughout the semester: two during Statics, one during Kinematics, and two again during Kinetics. The five multi-problem homework sets were limited to no more than three problems each, but these problems would be more challenging and open-ended than in previous semesters. An additional homework component was then deemed necessary to develop the students' problem solving skills to the level necessary to tackle these more advanced multi-problem homework sets.

Again, several options were consider for the additional homework component for the spring semester of 2000. A web based homework system, a common trend in education (McCollum [27]; Poindexter, Heck and Ferrarini [28]; Vikas and Gramoll [29]), was initially considered. However, the authors were concerned that certain critical skills, such as drawing free body diagrams could not be adequately assessed. Another option was to issue ungraded home study problems. The incentive for the student to complete them was that one or more of these home study problems would appear on the exams. However, the instructors did not believe this incentive would be sufficient for students to work on the problems consistently throughout the semester. A variation of the home study problem considered, but rejected, was to collect them and assign points for each problem completed regardless of the solution procedure. Finally, the Daily Fundamentals were designed after considering these and several other options. The Daily Fundamentals would meet the original four goals by providing an additional homework component that was specifically designed to maximize the students' time on critical material without overloading them and to provide an efficient assessment opportunity for the instructors.

V. Daily Fundamentals

The Daily Fundamentals were essentially very short multi-problem homework sets assigned after the majority of the daily lessons, averaging 29 Daily Fundamentals per course over the last four semesters. The Daily Fundamental requirements for the entire semester were given to the students as a handout at the start of the course and were numbered for assignment in specific lessons. They were assigned so there would be no conflict with other requirements such as one of the five multi-problem homework set submissions or the three exams. Therefore, the students were never required to complete more than one requirement per lesson. Each Daily Fundamental assigned for a specific lesson consisted of one or two pages, with one problem on each side. Hence, an individual "problem" was defined as one side of the paper, which resulted in two or four problems assigned per Daily Fundamental for a specific lesson.

The Daily Fundamentals consisted of mechanics problems and/or answering questions from the assigned reading in the text. The mechanics problems were designed to reinforce the material taught in the lesson most recently completed. The reading questions were for the upcoming lesson with the intent of getting the student to read ahead in the text for the upcoming material. There was sufficient space on the sheet provided to complete the mechanics problem or answer the text questions. The answers were provided for the majority of the mechanics problems. This encouraged the students to work through their errors to get the correct answer. Additionally, the students recorded on each problem the amount of time it took them to complete that problem. This time record was used to assess the effectiveness of the Daily Fundamental homework system and provide the instructor with a tool for counseling the students.

Each Daily Fundamental problem or page side was worth three points out of a possible 2000 total points in the course. However, of these three points, only two were "hard points" and the third point was a bonus point. The grading scale was greatly simplified considering only three points possible per problem. A score of three was awarded for the correct and complete answer shown with all work in a neat and orderly manner. A score of two was awarded for any effort from 50 – 99%. A score of one was awarded for any effort less than 50% or if the student "copied" a solution from another student. A score of zero applied only to no work done on the problem. A score of two was the most frequent score and this represented a solid effort at the problem with minor errors in the calculations or required drawings, incomplete answers or missing information for the text questions. In general, the students were hesitant to raise issue with the scoring system because they still scored 100% on the problem with only 2 out of 3 points awarded per problem. The bonus point was the "carrot" to go the extra mile to figure it all out (answers were given!) and provide neat and orderly solutions. An additional incentive to working the problems was that one of the Daily Fundamentals appeared in the exact same format with the same numbers on each of the three full period exams. These repeat problems were worth 35 out of the 250 points possible in each of the three exams.

Instructors used the Daily Fundamentals as a transition from the previous lesson to the next lesson. Depending on available time, instructors reviewed some or all of the Daily Fundamental solutions and had the students correct their own or each other's work. Care was taken to ensure a separate colored pen/marker was used during the "correcting" period to separate the before-class work from the in-class corrections on the Daily Fundamental. This review period provided

immediate feedback to the instructor as to how the students were doing by simply asking questions during the solution presentation.

The instructors completed their individual student assessments by grading each Daily Fundamental problem and recording the students' score and time for completion data. Although the Daily Fundamentals were frequently assigned, their grading and assessment was done quickly because the students did well given the answers and the problems were short by design such that the solution would fit on one page. In general, the instructors focused more on the solution procedure rather than the details of the solution because of the straightforward scoring system of the simplistic problems.

A sample Daily Fundamental with a mechanics problem on the front and text questions on the back is included as Figure 1a and 1b. Note the simplicity of the problem, space for solution, grading scale and the area to note the time required to complete the problem. This Daily Fundamental was assigned after the last lesson in truss analysis, prior to the first lesson on frame analysis. The first problem on the front side reinforced the lessons on truss analysis. The second problem on the backside introduced the student to the upcoming frame analysis lessons by getting them into the textbook material. The instructor had the option of reviewing the truss problem during the next lesson if needed to reinforce that material and/or use the reading questions on the frame material to introduce the next topic.

VI. Effect Of The Daily Fundamentals

The Daily Fundamental homework system was used for the past two in EM302, which consisted of two spring semesters (AY 00-2 and AY 01-2) and two fall semesters (AY 01-1 and AY 02-1). Data in several categories was collected to assess the effectiveness of this homework system. In some categories, the data was compared against the two most recent semesters that did not use the Daily Fundamentals: spring semester AY 99-2 and fall semester AY 00-1. For each Daily Fundamental, the average completion time and score were recorded. Additionally, a separate overall time survey was conducted for all forty lessons during the semesters. The students were anonymously surveyed at the start of each lesson for their overall time spent on the course material since the previous lesson. The Daily Fundamental data and the overall time survey results were averaged for each of the course's main blocks of material: Statics, Kinematics, and Kinetics. Finally, the test averages for each of these blocks and the overall course final average are included for comparison in Tables 1 and 2.

A. Effect On Course Averages

The academic performance of the students was first analyzed to see if the Daily Fundamentals had an apparent impact on student grades. Figures 2 and 3 focus on the course averages from Tables 1 and 2, respectively. The two semesters without Daily Fundamentals were compared to the four semesters with Daily Fundamentals. There were some increased averages in the separate blocks of the course, but overall the course averages did not change significantly or decrease due to the introduction of the Daily Fundamentals.

B. Effect On Outgoing GPA Compared To Incoming GPA

The incoming and outgoing grade point averages (GPA) averaged for all the students in the course provided a before and after glimpse of their academic performance in the course. The GPA reflects the distribution of letter grades rather than the raw course average. Figures 4 and 5 show the average incoming and outgoing GPA of all the students in the course for each of spring and fall semesters, respectively. The incoming GPA reflects the students' average for all their courses up to EM302 and the outgoing reflects the EM302 average. The two semesters without Daily Fundamentals were again compared to the four semesters with Daily Fundamentals. In summary of these assessments, the Daily Fundamentals did not appear to have a significant impact on the quantifiable measures of the students' academic performance.

C. Effect On Cadet Self Assessment Of Their Learning

The United States Military Academy requires students to complete an end-of-course survey using an anonymous web-based feedback system. It is mandatory for them to complete the surveys and provides an excellent course assessment opportunity. The EM302 end-of-course web-based survey asked the students to self-assess their competence in the course's nine learning objectives:

1. Draw free body diagrams.
2. Apply equilibrium equations to calculate external reactions for rigid bodies, member forces in trusses, internal pin reactions in frames, internal forces and geometric constraints for cable systems and impending motion conditions for static dry friction problems.
3. Define and calculate the displacement, distance, velocity and acceleration for particles in rectilinear and curvilinear motion.
4. Calculate the linear and angular velocities of rigid bodies in translation, rotation about a fixed axis, and general plane motion.
5. Calculate the linear and angular accelerations of rigid bodies in translation, rotation about a fixed axis, and general plane motion.
6. Calculate the mass moment of inertia, $I_{G,}$ about the center of mass, and I_O about a point other than the center of mass.
7. Solve two-dimensional kinetics problems using the kinetics method of Force-Acceleration.
8. Solve two-dimensional kinetics problems using the kinetics method of Work-Energy.
9. Solve two-dimensional kinetics problems using the kinetics method of Impulse-Momentum.

The students rated themselves on a scale of one to five with five representing an "excellent" level of competence for a particular course learning objective. The results are shown in Figures 6 and 7. Again, there is not a significant change in the survey results between the semesters without the Daily Fundamentals and the four semesters with the Daily Fundamentals. There were mostly downturn results in the spring semesters and some upturned results in the fall semesters. Overall, the course averages, GPA's, and web-based feedback survey results do not prove a positive impact of the Daily Fundamental. These results were disappointing, but the original goals of the Daily Fundamentals were not to increase the students' academic performance.

D. Effect On Out-Of-Class Student Time On The Course

The students spent an average of approximately 28 minutes on each Daily Fundamental per lesson throughout the past four semesters. Compared to the overall time survey results, the time spent on the Daily Fundamentals represented only a portion of their total time spent on the course material. The overall time survey data was plotted in a graph of the average time per lesson versus each lesson. These figures are included for the spring and fall semesters as Figures 8 and 9, respectively. Data lines are included for the semesters without Daily Fundamentals for comparison to the semesters with Daily Fundamentals in each of the two graphs. Additionally, the final overall average time per lesson for each of the semesters are shown as a data table on the two graphs. Several interesting trends are observed in these graphs. First, in each of the spring and fall semesters without the Daily Fundamentals, the students' time surveys indicated spikes coinciding with each course requirement followed by little or no time spent on the course between graded assignments. Comparatively, for the semesters with Daily Fundamentals, spikes were still observed for the course requirements, but the data lines did not usually dip as low as the semesters without Daily Fundamentals. This is a positive observation because it represents a more continuous effort on the part of students. Additionally, a steady increase was seen in the average time for each semester. The average time spent on each lesson has risen from 58 minutes to 74 minutes for the spring semesters and from 67 minutes to 84 minutes for the fall semesters. These increases were directly related to the more consistent time average and to somewhat greater time spikes observed for the five full homework sets required in the semesters with the Daily Fundamentals. These more challenging multi-problem homework sets resulted in greater time spent prior to their turn-in date. Considering these increased time averages, a positive increase in the academic performance should be observed if "time on task" is a positive contributor to student performance. However, these positive effects were not observed as previously discussed for the course averages, incoming/outgoing GPAs and the course objectives survey.

E. Effect On National Standardized Engineering Tests

The national Fundamentals of Engineering (FE) Exam administered each year provided one more area of observable academic performance for comparison. A significant portion of this national standardized exam consists of engineering mechanics material. Clearly, the students' performance on this exam would address their retention of the material taught in the EM302, Statics and Dynamics course. Figure 10 shows the overall average passing percentage of the Civil and Mechanical Engineering majors at USMA relative to the national average for the same group. The USMA average passing rate has been consistently 89% over the last three years during which the national average has decreased from 83% to 79%. This is a positive indicator that the Daily Fundamentals have not adversely affected the students' performance on the FE and may have helped when compared to the national average.

VII. Course Critique Results

A. Student Critiques

The significant increase in the average time per lesson for semesters with Daily Fundamentals could have resulted in negative feedback from the students, counter to the intended goals of the Daily Fundamentals. Interestingly, the students in each of the four semesters with Daily Fundamentals responded favorably to the new homework system. Their positive responses were evident in two end-of-course critiques: an in-class written critiques and an out-of-class web-based feedback system.

In-class written critiques are administered in the final lesson of EM302 for each semester. The students are asked to provide anonymous written critique of their instructor and the course. The first question in the course written critique is open-ended and asks the student, "What did they like about the course?" The top responses every semester included the following:

1. Instructors (knowledgeable, motivated, energetic, sincere, imaginative),
2. Method of instruction (interactive classes, demonstrations),
3. Material (exciting real-world applications),
4. Homework (problem sets and Daily Fundamentals).

It was very interesting to routinely see homework as one of the top four choices for what the students "liked" about the course. Some of their specific responses to the Daily Fundamentals included the following and provided some positive antidotal evidence:

- *"The Daily Fundamentals were very important part of my learning. They were worth points and thus forced me to do my homework."*
- *"They [Daily Fundamentals] focused me on the important topics."*
- *"Daily Fundamentals were a great asset to me as a student. I can attribute about 90% of my success in the course to the DFs."*
- *"The DFs were the most helpful to my learning."*
- *"Those DF questions and the reading log problem sets were quick and solid introductions to upcoming class material."*
- *"They [Daily Fundamentals] kept me on track in the course."*

The other standard question on the course written critique asked the students to make recommendations on ways to improve the course. The Daily Fundamentals were never identified as a course requirement that should be eliminated and frequently the students recommended assigning more Daily Fundamentals over the multi-problem homework sets.

The same anonymous web-based feedback system that required students to self-assess their competence in the course's nine learning objectives asked the students to rank eight items in order of importance to their learning of the course objectives. The eight items were:

1. Textbook,
2. Tests,

3. Graded Homework (Problem Sets),
4. Graded Homework (Daily Fundamentals),
5. Board Work Lessons (where the students work solutions at the board),
6. Solutions on the Course Web Page,
7. Solutions in the Course Solution Room,
8. In-class Demonstrations.

In each of the four semesters with Daily Fundamentals, the students ranked the Graded Homework (Daily Fundamentals) as number one and In-Class Demonstrations as number two items that were most important to their learning of the course objectives. This is shown in Figure 11 with percentages for the top two answers and the remainder for the other choices.

B. Instructor Critiques

The course instructors were also surveyed for their thoughts on the Daily Fundamentals. They unanimously agreed that the Daily Fundamentals provided the following:

- A positive learning tool,
- A continual and immediate assessment system without excessive amount of time required to implement the system,
- A decreased grading workload because of the Daily Fundamentals simple problems and grading system,
- A continual building of course material that could culminate in more complicated problem sets.

VIII. Conclusions

There are several conclusions that can be drawn from the analysis of the Daily Fundamentals that were administered in the Statics and Dynamics course at USMA the last four semesters.

- The Daily Fundamentals met the requirement for an intermediate level homework problem from which students could develop the skills required to tackle more difficult and lengthy multi-problem homework sets.
- The Daily Fundamentals did not have a significant effect on the students' academic performance as measured by course averages, incoming versus outgoing GPAs or a survey of the students' comprehension of the course objectives.
- The Daily Fundamentals had several effects on the students' out-of-class time associated with the course. Students still procrastinated for the non-Daily Fundamental homework requirements and this resulted in large time spikes prior to their turn-in dates. However, the Daily Fundamentals caused the students to maintain a more consistent time per lesson average than previous semesters without Daily Fundamentals. Additionally, there was an increase in the average out-of-class time per lesson over the last four semesters.
- The Daily Fundamentals did not appear to affect the performance of USMA students on the national Fundamentals of Engineering (FE) Exam. These students have consistently maintained an 89% pass rate over the past three years, which is significantly better than the national average over those same years.

- The students indicated quantifiably and anecdotally in course written and web-based critiques that they liked the Daily Fundamentals and believed they were important to their learning of the course objectives.
- The instructors unanimously agreed that the Daily Fundamentals were a positive learning tool, provided an effective student assessment tool and did not significantly increase their grading workload.

IX. Recommendations

The Daily Fundamentals were a solution to specifically address minor shortcomings in a course with specially designed homework. As engineering educators, we should address apparent problems in our engineering education and apply logical and systemic changes as shown in this paper. These changes must then be assessed to see if they meet the intended goals and/ or result in unexpected outcomes.

The Daily Fundamentals did not appear to have a significant effect on the students' academic performance. However, both the students and instructor praised the Daily Fundamentals as a great learning and assessment tool. Further analysis may provide additional insight into the interesting observations seen above in the conclusions. Lohman [30] says " effectively integrating those outside hours with class meetings may be challenging, even for experienced college instructors; nevertheless, outside assignments offer the best means of meeting a variety of learning objectives". But, then, how can a homework system that increases the students' out-of-class time and is well liked by the students and instructors not have a positive impact on measurable academic performance? Because of this interesting result, the Daily Fundamentals will continue to be used and assessed in the Statics and Dynamics course at USMA for future semesters.

Other engineering programs should consider how some of the unique features of the Daily Fundamentals could possibly fit into their engineering mechanics course and have a positive impact. The unique features to consider are:

- Frequently assigned homework that keeps the students on track in the course.
- Different levels of homework problems with a specifically designed sequence that builds the students' confidence and proficiency.
- Giving answers to the problems, which encourages the students to work through their errors and results in easier grading because the instructor can focus on the problem solution procedure.
- Simplified grading that recognizes the student workload, but encourages them to try several problems to increase their understanding of the course material.
- Include some homework problems on exams as an extra bonus for those students who spend the time to really understand the solution procedure.
- Record student time required to complete homework assignments to monitor their workload and identify problem areas where the students may be "spinning their wheels".

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Biography

JOSEPH P. HANUS
Joseph P. Hanus is an Assistant Professor and Course Director for EM302, Statics and Dynamics, at the United States Military Academy, West Point, NY. joseph.hanus@usma.edu.

MARK D. EVANS
Mark D. Evans is an Associate Professor and Group Director in the Civil Engineering Division of the Department of Civil and Mechanical Engineering at the United States Military Academy, West Point, NY. mark.evans@usma.edu.

MARK E. ORWAT
Mark E. Orwat is an Instructor and Assistant Course Director for EM302, Statics and Dynamics, at the United States Military Academy, West Point, NY. mark.orwat@usma.edu.

Semester	Statics	Kinematics	Kinetics	Course Final Avg
AY 99-2 (without DFs)				
Test Avg	91.7 %	87.1 %	87.4 %	89.0 %
AY 00-2 (with DFs)				
DF Avg Time	27.3 min	23.9 min	25.3 min	
DF Avg (out of 6 pts)	4.99	4.79	4.37	
Test Avg	86.0 %	87.9 %	82.0 %	86.7 %
AY 01-2 (with DFs)				
DF Avg Time	38.6 min	32.8 min	23.7 min	
DF Avg (out of 6 pts)	4.81	4.93	3.96	
Test Avg	88.8 %	85.1 %	81.1 %	87.0 %

Table 1, Daily Fundamental (DF) Data, Spring (primarily engineering majors)

Semester	Statics	Kinematics	Kinetics	Course Final Avg
AY 00-1 (without DFs)				
Test Avg	82.1 %	81.2 %	81.0 %	86.4 %
AY 01-1 (with DFs)				
DF Avg Time	33.0 min	26.7 min	27.5 min	
DF Avg (out of 6 pts)	4.67 pts	4.57 pts	3.96 pts	
Test Avg	81.5 %	85.2 %	78.3 %	85.0 %
AY 02-1 (with DFs)				
DF Avg Time	30.9 min	27.4 min	21.1 min	
DF Avg (out of 6 pts)	4.10 pts	3.48 pts	3.10 pts	
Test Avg	82.2 %	85.4 %	77.4 %	84.0 %

Table 2, Daily Fundamental (DF) Data, Fall (primarily non-engineering majors)

EM302 DAILY FUNDAMENTALS #9
LSN 9, Truss Analysis II

Name:_____ Section:_____ Hour:_____

Score: _____ (1: <50%, 2: >50%, 3: 100%) Approx. Time to Complete: _____ min

1. The truss shown below is externally supported with a roller at C and a pin at E. Find the forces in members BD, BC, and DE for the truss shown below.
(ANS) $\mathbf{F}_{BD}$ = 200 N (T), $\mathbf{F}_{BC}$ = 0, $\mathbf{F}_{DE}$ = 167 N (T)

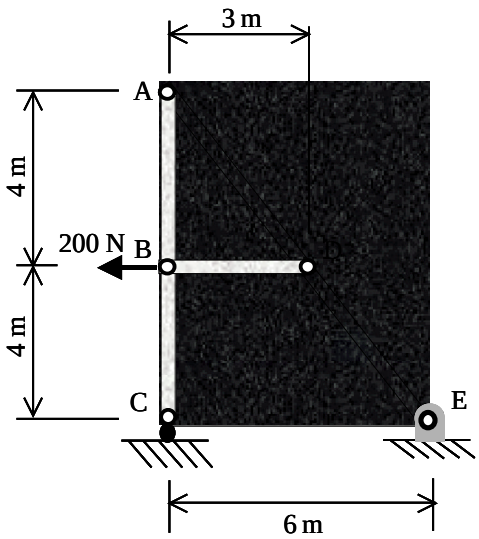

Figure 1a, Sample Daily Fundamental (front side)

EM302 DAILY FUNDAMENTALS #9
LSN 9, Truss Analysis II

Name:_____ Section:_____ Hour:_____

Score: _____ (1: <50%, 2: >50%, 3: 100%) Approx. Time to Complete: _____ min

2. Answer the following questions in reference to the reading f or Lesson 10.

What is the common element in **frames** and **machines**?

What is the difference between **frames** and **machines**?

What is one difference between **frames** and **trusses**?

Figure 1b, Daily Fundamental (back side)

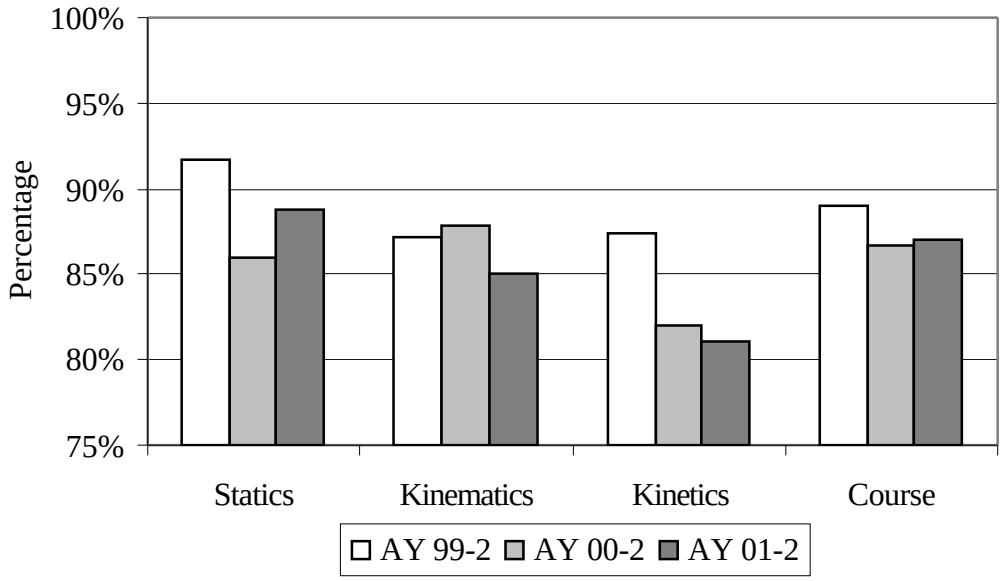

Figure 2, Course Averages, Spring (primarily engineering majors)

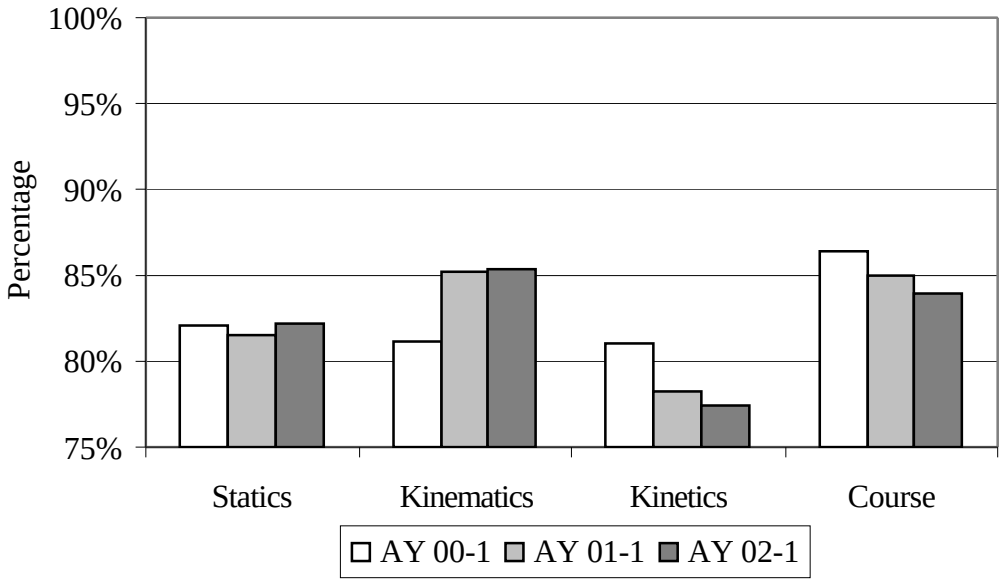

Figure 3, Course Averages, Fall (primarily non-engineering majors)

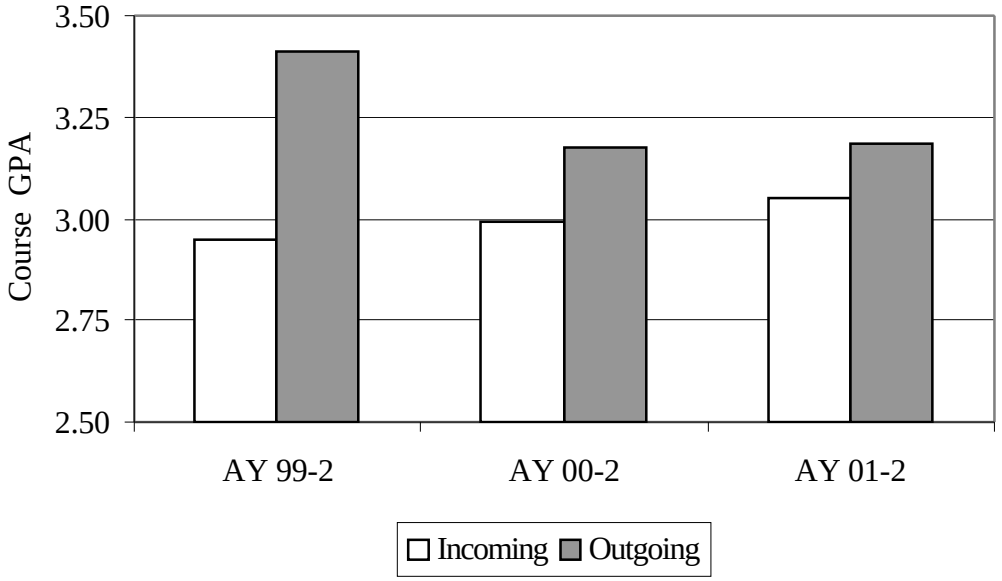

Figure 4, Course Grade Point Average (GPA), Spring (primarily engineering majors)

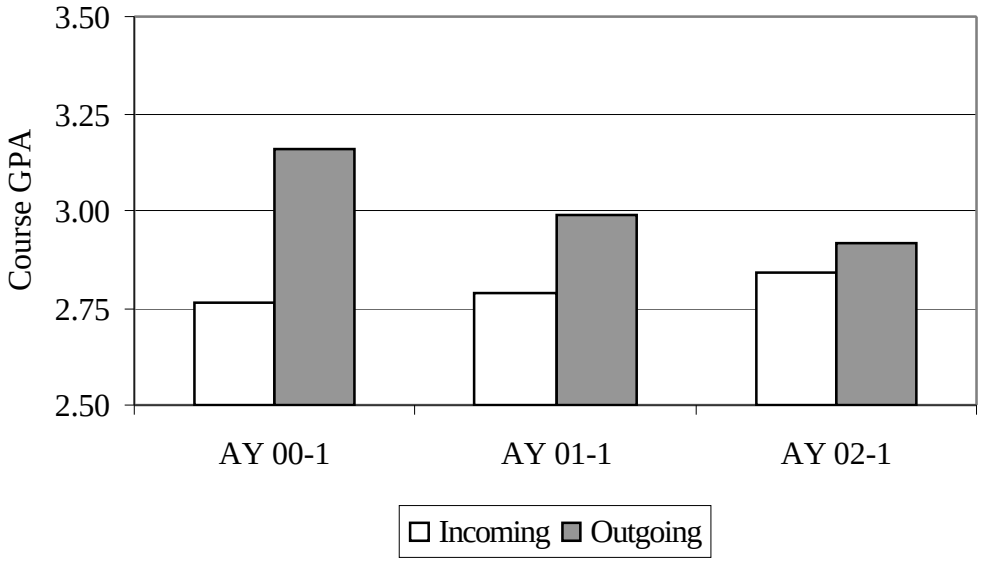

Figure 5, Course Grade Point Average (GPA), Fall (primarily non-engineering majors)

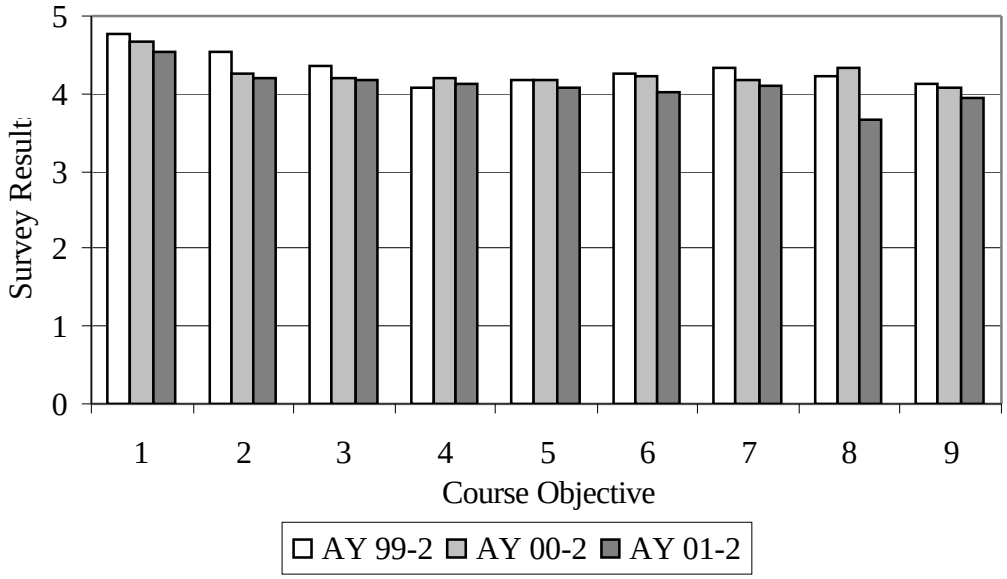

Figure 6, Course Objectives Survey, Spring (primarily engineering majors)

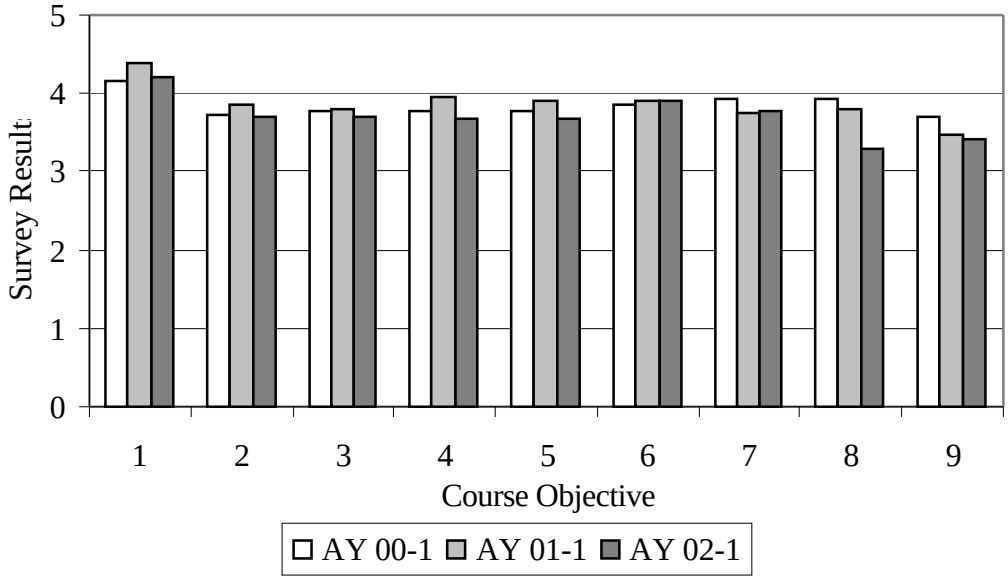

Figure 7, Course Objectives Survey, Fall (primarily non-engineering majors)

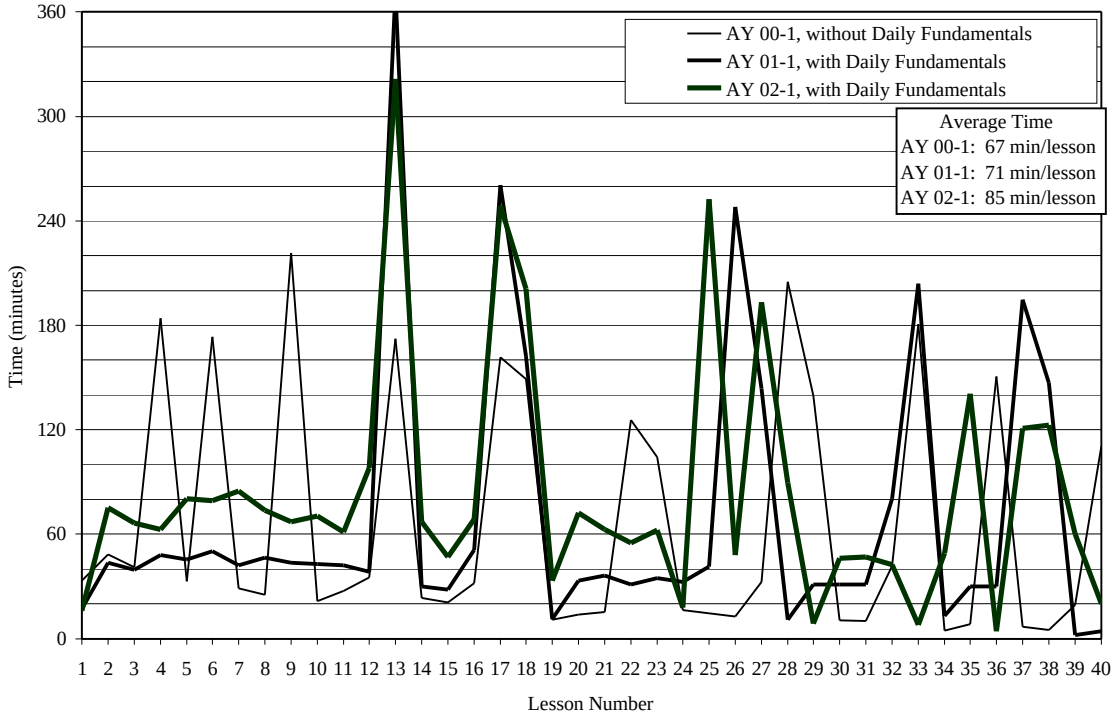

Figure 8, Course Time Survey, Spring (primarily engineering majors)

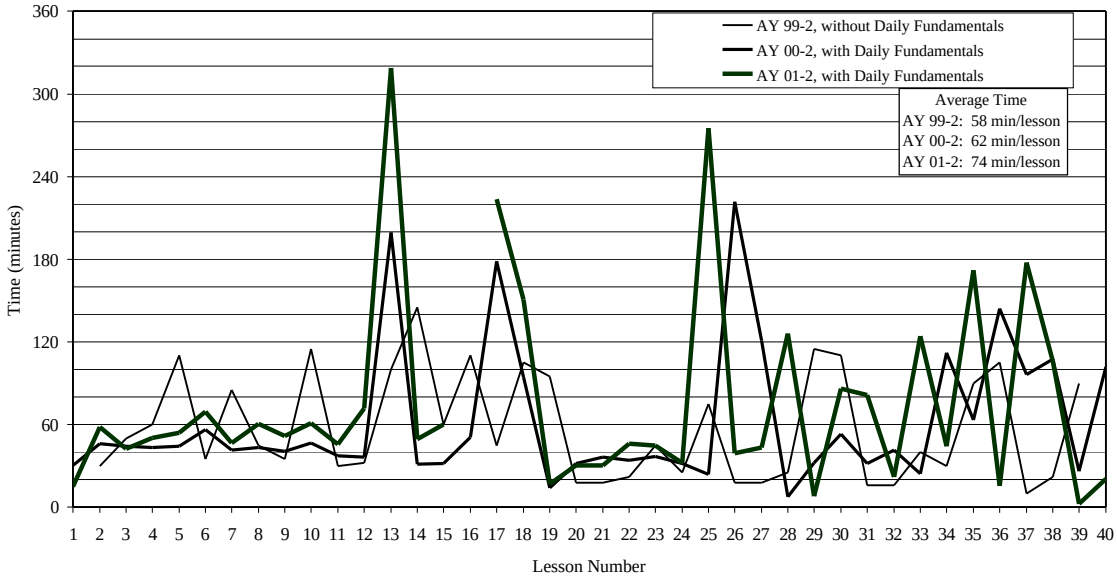

Figure 9, Course Time Survey, Fall (primarily non-engineering majors)

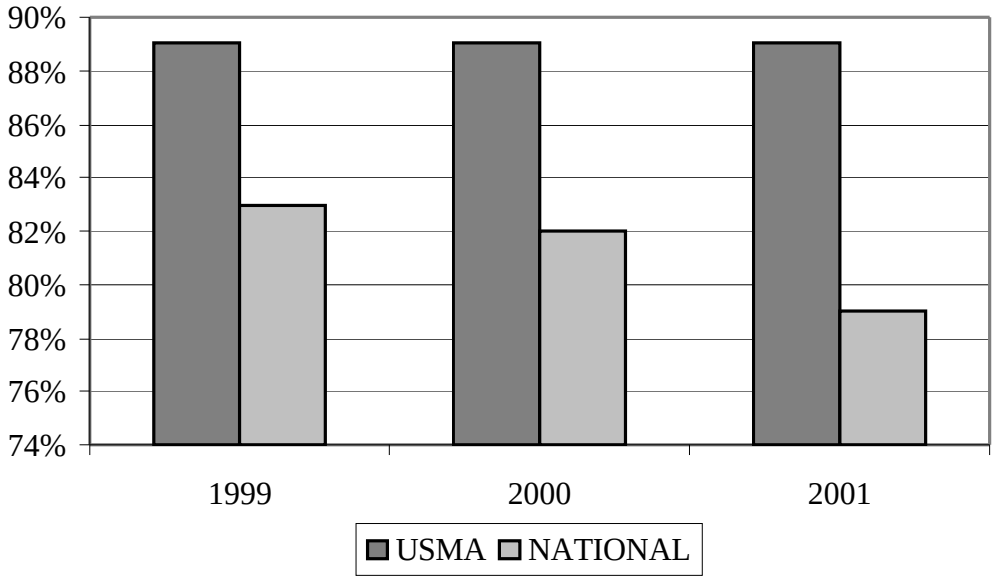

Figure 10, FE Results, (Civil and Mechanical Engineering Majors only)

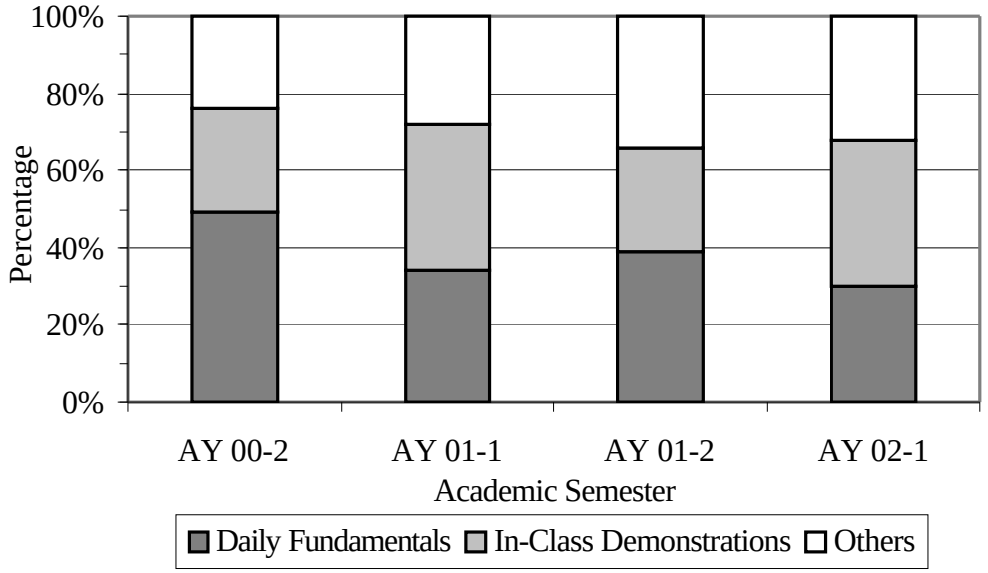

Figure 11, Percentage Of Students Selecting As The Most Important To Their Learning Of The Course Objectives