A la Carte Grading: Providing Students Opportunities to Determine their Own Paths to Success

James A. Thompson* and Larry J. Grabau

ABSTRACT

One goal of most courses is to prepare students with basic knowledge and skills associated with the course content. Mastery learning can be a rewarding way to encourage greater student achievement by allowing students multiple attempts to demonstrate an understanding of course concepts. This may involve repeated submissions of individual assignments or selection from multiple assignments for a single submission. However, such techniques can be unsustainable in large classes where additional evaluation and grading taxes instructor time and resources. For two large enrollment (>50) introductory level courses (PLS 366: Fundamentals of Soil Science; PLS 104: Plants, Soils, and People) offered in the Department of Agronomy at the University of Kentucky we implemented an adaptation of the mastery learning approach that encourages broader comprehension of course material and recognizes different learning styles, but does not require all students to redo all incorrect work. Instead, students are required to complete a minimum number of assignments, and then they are given the option to complete additional work that can be substituted for other completed assignments. In general, student perception of these grading systems were favorable; however, students did not seem to take full advantage of the available options because many did not choose to complete the additional assessments that could demonstrate further learning and be used to improve their course grade.

ONE GOAL OF MOST COURSES is to prepare students with basic knowledge and skills associated with the course content. This may be particularly important in introductory level courses that serve as prerequisites for additional courses in the topic area.

Learning, Teaching, and Instructional Paradigms

John B. Caroll's model for school learning describes student learning as a function of the student's perseverance and opportunity to learn, relative to the student's aptitude, the quality of instruction, and the student's ability to understand the instruction (Block and Anderson, 1975; Guskey, 1997). Of these, the instructor is responsible for the opportunity to learn and the quality of instruction. The others (perseverance, aptitude, and ability to understand instruction) are dependent upon the student. For an instructor who has made a commitment to high-quality instruction in the classroom, his or her primary role becomes providing students with ample opportunities to learn. A mastery learning approach provides a framework for instructors to provide these opportunities.

J.A. Thompson, Dep. of Soil Science, North Carolina State Univ., Raleigh, NC 27695-7619; and L.J. Grabau, Dep. of Agronomy, Univ. of Kentucky, Lexington, KY 40546-0312. *Corresponding author (james_thompson@ncsu.edu).

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677 S. Segoe Rd., Madison, WI 53711 USA

Mastery learning is a philosophy that contends that all students can learn, and will achieve a high level when they are given proper occasion to do so. Two common mastery learning approaches are (i) learning for mastery (LFM), which is group-based, teacher-directed, and more commonly adopted in primary and secondary levels; and (ii) personalized systems of instruction (PSI), which is individual-based, student-directed, and more typically implemented at the college level (Kulik et al., 1999; Guskey, 1997). Student-directed learning is a valuable approach because it encourages students to become independent life-long learners. With PSI the instructor is mainly a resource to supplement readings, exercises, and other prepared instructional tools. The "modular" audio-tutorial design is an example of how PSI is used in a university setting. The contact between student and instructor, which is an important component to student motivation and commitment to learning (Sturnick and Conners, 1995), is minimized. Conversely, in LFM, the teacher is the primary source of instruction. A third form of mastery learning is the phase achievement system (PAS) (Stinard and Dolphin, 1981), which has more frequent testing, a lower level of "mastery," and gives students more choices among which tests are used to determine grades. Each of these mastery approaches are intended to tailor the instructional process to the unique capabilities of each student by acknowledging and accommodating differences in factors that influence style and rate of learning, such as ability and prior preparation (Stinard and Dolphin, 1981).

As with any instructional method, the mastery learning approach is built upon a set of well-defined instructional objectives. Performance standards are then created to reflect the proper achievement of these goals, and summative assessments are created. The procedures used by the instructor to create the desired opportunities to learn include dividing the material into meaningful elements, creating and using formative assessments to evaluate student progress, and the development of supplemental instructional materials, which present material in alternative formats and are used to revisit areas of student deficiency identified by the formative assessment (Block and Anderson, 1975; Guskey, 1997). Other key components to mastery learning methods include frequent evaluation (both formative and summative) and feedback that is both frequent and specific.

Student Motivation and Goals

The instructor shares responsibility for learning with the students, who are accountable for perseverance, aptitude, and ability to understand instruction. Of these, we often assume that students who have achieved entrance to an institution of higher education most likely have the aptitude and the ability to understand instruction. Therefore, perseverance, which is driven by motivation, is often a "limiting factor" to student

Abbreviations: LFM, learning for mastery; PAS, phase achievement system; PSI, personalized systems of instruction; TCE, teacher–course evaluation.

learning. Ames (1992) identifies two different types of achievement goals that are at the heart of student motivation. The first, *learning goals*, guide students toward attaining a certain level of mastery of course information, with the reward being self-fulfillment and knowledge of a job well done. While the instructor defines mastery levels necessary to attain each grade, much of the motivation must come from the student. This is typically in the form of greater involvement, which leads to greater learning (Ames, 1992). In contrast, *performance goals* guide students toward merely earning a certain grade, doing better than peers, or maximizing their grade while minimizing their effort. Performance goals are more clearly student-defined, and learning may be reduced to a means to obtain the desired grade. So while adoption of learning goals connotes a student who has accepted an active role in and responsibility for their own education, adoption of performance goals may be associated with avoidance of educational challenges and reliance upon short-term memorization and other superficial learning practices (Ames, 1992). Which type of goal students select for their education is dependent upon their past academic success and their personal value of education (Ames, 1992). For some college students, this goal orientation can vary among courses, with courses in a student's major or courses of greater personal interest approached with a learning goal, and required nonmajor courses or courses on topics not valued by the student approached with a performance goal.

OUR APPROACH

Considering these complex interactions among the responsibilities of both the instructor and student in the learning equation, while still appreciating the constraints on both the students and instructor in terms of time and resources, we devised versions of a mastery learning approach for two introductory courses through the plant and soil science curriculum in the College of Agriculture at the University of Kentucky.

PLS 366: Fundamentals of Soil Science

This course was designed to introduce students to some fundamental concepts of soil science and develop their understanding of properties and processes basic to soil use and management.

Students in this course included majors from plant and soil science, natural resources conservation and management, agricultural education, landscape architecture, and animal science, with minor representation from agricultural biotechnology, agricultural engineering, geology, forestry, agricultural economics, geography, and biology. The class was almost exclusively juniors and seniors, with only a few sophomores enrolled per semester.

Upon successful completion of PLS 366 the student should be able to:

1. Describe the important role of soil in the environment and its contributions to both agricultural and nonagricultural systems.
2. Communicate clearly with common terms used by soil scientists.
3. Describe the fundamental physical, chemical, mineralogical, and biological properties of soils, interactions among these properties, and their effects on plant growth, soil behavior, and soil management.
4. Explain the role of soils in the landscape, particularly as related to the soil's participation in the major cycles of matter and energy (hydrologic cycle, carbon cycle, etc.).
5. Infer basic differences among soils formed under the influence of differences in climate, organisms, relief, parent materials, or time.
6. Use soils information (e.g., from soil survey reports or collected from field studies) and understand the benefits and limitations of these data for various land use purposes.

Mastery Learning Approach and Assessment Strategy

The semester was divided into four sections. After the first section, in which each student completed two homework exercises and one exam, individuals could choose to complete (i) the homework exercises (two per section), (ii) the exam (one per section), or (iii) both. The homework questions and exam questions were short-answer essay questions (e.g., "Considering both gains and losses of organic matter, why do agricultural soils [i.e., cropland] generally contain much lower levels of organic carbon than similar soils under natural vegetation? Explain you answer. Be specific."). Furthermore, the questions used on homework exercises and exams were interchangeable, such that the same (or similar) question may appear on a homework exercise one semester and be on an exam in another. (These questions were also used during lecture periods as in-class activities so that students could practice responding to such questions.) Any student who completed the homework exercises and the exam received the *best* score of the two: either the total score on the two homework exercises or the score on the exam, whichever was higher.

This system was modular, with each section of the course being a separate grading period. The instructor used multiple assessment tools, both formative and summative, including in-class exercises (ungraded), reading comprehension questions (ungraded), self-instructional exercises (ungraded), homework exercises, and exams. These varying methods were included to recognize the differences in achievement related to differences in learning styles among students. Because the student selected the summative assessment tools, this provided each student the opportunity to recognize differences in their learning style and select the evaluation method that capitalizes on that strength.

PLS 104: Plants, Soils, and People: A Global Perspective

This course was designed to introduce students to plant and soil science, beginning with a first unit on the outlook for feeding the additional billions of humans expected to be added to the global population by the middle of this 21st century. The second unit went into plant development and photosynthesis, along with soil properties and soil orders. Basic genetics and plant improvement through breeding were the key ideas of the

Table 1. Total enrollment (*N*) and division between students who completed homework exercises (n_{HW}) and exams (n_{EX}) by topic section and semester in PLS 366.

		Section 2		Section 3		Section 4		Mean	
Semester	*N*	n_{HW}	n_{EX}	n_{HW}	n_{EX}	n_{HW}	n_{EX}	n_{HW}	n_{EX}
Fall 1998	53	45	19	47	15	46	15	46	16
Spring 1999	65	60	16	58	13	62	5	60	11
Fall 1999	53	51	12	51	5	48	8	50	8
Spring 2000	54	52	22	51	8	48	8	50	13
Mean	56	52	17	52	10	51	9	52	12

third unit, while the fourth unit emphasized plant biotechnology.

While this course served as the introduction to the major for plant and soil science students, it was primarily a service course for students from as many as 12 other colleges besides the College of Agriculture. Nonmajors enrolled in the course to satisfy a University Studies Program requirement in either natural sciences or an area we referred to as "cross-disciplinary."

Upon successful completion of PLS 104 the student should be able to:

1. See the conflict between providing food and protecting nature
2. Get inside plants and dig into soils
3. Scope out the traditional ways we have improved plants
4. Understand the new plant biotechnologies
5. Write stimulating papers about plants
6. Be involved in plant science in the classroom

Mastery Learning Approach and Assessment Strategy

The course evaluation was divided into seven portions, of which five must be completed. Because this course was part of the University Studies Program, writing was required. By appropriately selecting among the choices, students could use writing pieces to count between 20 and 40% of their course grades (exams accounted for the remainder). Two different writing options were included and each student had to complete at least one of these two options. Paper 1, a creative piece of 600 to 750 words, was worth 50 points; Paper 2, an informative piece of 1200 to 1500 words, was worth 100 points. Meanwhile, Paper 3, a more difficult argumentative piece of 1800 to 2100 words, was worth 150 points. Completing either Paper 1 and 2 together, or Paper 3 alone would satisfy the minimum writing requirement for the course. Students had the option of avoiding an exam during the final exam period by completing all three writing assignments.

The course included a total of five multiple-choice exams, each worth 150 points: one at the conclusion of each of the four course units, and an additional review exam, given during the final exam period and covering the highlights of the first three course units. Students had to complete a minimum of three of these five exams. For example, if a student wished to avoid taking the fourth and fifth exams, she would need to satisfactorily (to her own standards) complete the first three exams and all three papers. Then, she would not be required to appear for tests four and five, and could concentrate on her other courses during final exam week. For students who completed more than the minimum of five options, including at least one of the two writing options, their grade was calculated as the combination of papers and exams that resulted in the best possible score. Students were not asked to let the instructor know which combinations of papers and exams they chose; in fact, some students clearly changed their plans as the semester proceeded. However, the grading policies were "no-fault" in the sense that a student who did more exams and papers than he was required to do would not be penalized for that additional effort.

RESULTS AND DISCUSSION

PLS 366—Fundamentals of Soil Science

The options-based grading system was utilized for four semesters, from fall semester 1998 through spring semester 2000. Enrollment during these four semesters ranged from 53 to 65 students (Table 1). Students who withdrew from the course or otherwise did not complete each of the four sections of the course were omitted from this analysis.

Although there was some variation among semesters, the majority of students (up to 92% during Section 4 of Spring 1999) chose not to take the optional exam at the end of each section, with the highest percentage of test takers being 41% (22 of 52) for the second section in spring 2000 (Table 1). Furthermore, the number of students who took the exam at the end of each of the sections tended to decrease throughout the semester (Table 1).

Homework assignments were returned at least 4 days before each exam. If a student then chose to take the exam, this could be interpreted as an indication that the student was not satisfied with his or her section grade based on homework scores. Conversely, if a student chose not to take the exam, this may be interpreted as an indication that the student was satisfied with his or her grade. As is seen in the participation numbers, the mean and extreme homework scores for both the students who took the exam and those who did not take the exam show interesting trends (Table 2). In general, the minimum homework score of the students that did not take the exam at the end of each section was lower at the end of the semester than at the beginning (Table 2). Similarly, the mean

Table 2. Mean homework (HW) scores for students in PLS 366 who only completed the two homework exercises (minimum in parentheses) and for those who completed both homework exercises and the exam (EX) (maximum in parentheses). Scores are reported as percentages of total points available.

	Section 2		Section 3		Section 4		Mean	
Semester	HW only	HW and EX	HW only	HW an EX	HW only	HW and EX	HW only	HW and EX
Fall 1998	90 (79)	63 (94)	77 (24)	53 (84)	80 (48)	48 (85)	82 (50)	55 (88)
Spring 1999	83 (70)	73 (86)	85 (69)	69 (84)	81 (48)	52 (78)	83 (62)	65 (83)
Fall 1999	84 (63)	66 (83)	85 (61)	61 (86)	86 (55)	45 (81)	85 (60)	57 (83)
Spring 2000	81 (52)	71 (92)	86 (59)	71 (89)	87 (71)	64 (78)	85 (61)	69 (86)
Mean	85 (66)	68 (89)	83 (53)	64 (86)	84 (56)	52 (81)	84 (58)	61 (85)

Table 3. Mean difference in exam (EX) scores for students in PLS 366 who obtained a higher score on the exam (mean for students who completed both homework [HW] exercises in parentheses) and for those who obtained a lower score on the exam. Scores are reported as points out of a possible of 50.

	Section 2		Section 3		Section 4		Mean	
Semester	If EX > HW, points more on EX	If HW > EX, points lower on EX	If EX > HW, points more on EX	If HW > EX, points lower on EX	If EX > HW, points more on EX	If HW > EX, points lower on EX	If EX > HW, points more on EX	If HW > EX, points lower on EX
Fall 1998	20.7 (5.5)	−13.3	17.5 (4.0)	−8.5	20.4 (3.1)	−4.8	19.5 (4.2)	−8.9
Spring 1999	20.8 (6.5)	−5.9	20.0 (7.0)	−6.5	19.4 (6.0)	0.0	20.1 (6.5)	−4.1
Fall 1999	11.0 (1.0)	−6.1	20.2 (0.0)	−3.7	16.0 (14.0)	−16.0	15.7 (5.0)	−8.6
Spring 2000	14.0 (4.5)	−6.7	18.0 (0.0)	−13.4	19.8 (0.0)	−17.0	17.3 (1.5)	−12.4
Mean	16.6 (4.4)	−8.0	18.9 (2.8)	−8.0	18.9 (5.8)	−9.4	18.2 (4.3)	−8.5

and maximum homework score of the students that did take the exam at the end of each section also decreased throughout the semester (Table 2). Overall, the mean homework score of the students who did not take the exam was 84%, and the mean homework score of the students who did take the exam was 61% (Table 2).

These trends indicated the changing attitudes and expectations that can occur during the course of a semester. Despite having an opportunity to "retake" an assessment for each section of the course, many students did not, with lower participation levels as the semester proceeded. Grading on the homework exercises was strict (by student standards). The high difficulty of the homework questions (and, by extension, the exam questions) may have fostered a "depressive attribution pattern" (Heckhausen, 1987) in which a student's self-evaluation is of having low ability and reduced opportunity for later success (Heckhausen, 1987). If this is the case, there is reduced motivation for taking the exams. The observed trend of decreasing participation levels may also be attributable to a lowering of standards or expectations as final course grades become less easily altered or as demands from other courses increase. In fact, the grading system may actually have been counterproductive to the originally intended goal of promoting greater student effort and learning. Pressley et al. (1998) cite examples of how both student motivation and achievement were reduced when students were given extra credit opportunities or other means to compensate for poor performance on other aspects of the course. To some extent, individuals may have weighed the required investment of time and effort to prepare for the exams against the potential return on that investment, and decided that the opportunity to elevate their grade was not worth the investment. However, there is no direct information (e.g., from student feedback) as to why this trend occurred.

For the students whose exam score was greater than their homework total for any given section, the mean improvement in exam score over homework score was 18.2 points (out of 50) (Table 3). However, much of this improvement can be attributed to students who did not complete both homework assignments and, by default, improved their score with the exam. When only those students who completed both homework assignments are considered, the mean improvement was much lower (4.3 points). For the students whose exam score was less than their homework total, the mean difference between these two scores was fairly large (8.5 points out of 50, or 17% lower) (Table 3). This was likely because most of the more motivated students put greater effort into their homework assignments so that they could opt not to take the exam. The students who took the exams but did not improve their scores seemed to be those who either (i) did not prepare adequately for the exam because they knew that their homework scores would still count, and thus there was no risk in just taking the exam; or (ii) did not possess the ability or the motivation to increase their efforts to master the material following the feedback they received on homework exercises.

Exam scores were consistently lower than homework exercise scores (Table 4). While the mean homework score for each section remained constant, the general trend for exam scores was to decrease throughout the semester. In two of the four semesters, Exam 2 scores were less than those of Exam 3. Section 2 covers soil chemistry, and there was generally a poor level of preparation in chemistry among the students. Some students enrolled in PLS 366 without having taken the general chemistry prerequisite (CHE 105). Also, by the end of the fourth and final section, many students appeared to be less motivated or to have lost interest. The number of students who opted to take Exam 4 was usually small (Table 1), and it was often only the lower achieving students who chose to take Exam 4 (Table 2), leading to the low average score (Table 4).

This options-based method of grading did not appear to be inflating grades in this course. Mean overall scores in the two semesters before the change in grading format were 79.6 and 78.2%. Mean overall scores in the four semesters using the options-based grading format were 80.1, 81.6, 79.0, and 78.0%.

Student response appeared to be overwhelmingly favorable to the options-based grading method. Based on four semes-

Table 4. Mean homework (HW) totals and exam (EX) scores for all students in PLS 366. Points are out of a possible 50 for each assignment.

	Section 1		Section 2		Section 3		Section 4		Mean	
Semester	HW	EX	HW	EX	HW	EX	HW	EX	HW	EX
Fall 1998	42.7	35.8	44.1	33.9	38.9	38.6	39.6	35.2	40.9	35.9
Spring 1999	41.7	39.0	40.8	38.2	41.9	36.6	40.3	36.2	41.0	37.0
Fall 1999	38.1	35.4	40.8	31.2	42.3	36.6	42.1	24.8	41.7	30.9
Spring 2000	39.1	36.8	39.1	31.9	43.0	29.6	43.2	22.6	41.8	28.0
Mean	40.4	36.7	41.2	33.8	41.5	35.4	41.3	29.7	41.3	33.0

Table 5. Student grading choices made during a sample semester in PLS 104. "Preliminary choice" indicates student choice as revealed by the submission of a given paper or taking a given exam. "Final choice" indicates the selection made by the instructor at the end of the semester, reflecting the requirement to count either Paper 1 and Paper 2 or Paper 3 as writing evaluations.

Course assignment	Preliminary choice	Final choice
	% completed	% used
Paper 1	87	77
Paper 2	74	77
Paper 3	34	35
All three papers	12	12
Test 1	100	99
Test 2	95	76
Test 3	93	73
Test 4	82	77
Test 5	78	65

ters of responses from Teacher–Course Evaluation (TCE) surveys, there was 84.8 to 92.7% (mean = 88.9%) agreement to the statement, "I liked the grading system" and 72.2 to 93.8% (mean = 86.5%) agreement to the statement, "The grading system encouraged me to learn more in this course." Specific student comments were:

> *The grading system encouraged me to visit the instructor and make sure I did well on homework. It helped me better use the book too.*
>
> *I enjoyed the grading system. I think that it made people take the homework more seriously and learn more.*
>
> *I really like the grading system. It gives us the opportunity to do well if we aren't good test-takers.*
>
> *The grading system was very beneficial. It encourages more study and work in the course, especially on homework and reading.*
>
> *I liked the grading system. It encouraged me to do the homework assignments well so I would not have to take the exams. The homework and exams were of comparable difficulty, but you couldn't use the book or other resources on the test, which made them much harder.*
>
> *[The grading system] made me put in more effort on my homework. This method of grading resulted in learning, whereas having to cram for a test does not.*

PLS 104—Plants, Soils, and People: A Global Perspective

Students in PLS 104 had a more varied set of choices available to them, but their choices from a representative section of PLS 104 from fall semester 1998 (Table 5) reflect similar behaviors to those observed in PLS 366. As before, students who withdrew from the course or otherwise did not complete the course were omitted from this analysis.

As expected, students preferred to complete Papers 1 and 2 (the two shorter pieces) rather than Paper 3, which was longer and more difficult. A small percentage of the class (12%) chose to write all three papers; at the end of the term, all of those who had chosen to write all three papers included those scores in their course evaluation.

A total of four students took advantage of the possibility of exemption from the final exam (two with A's; two with B's). The instructor was somewhat surprised that more students did not take advantage of this option. Apparently, the inclusion of three papers in that option dissuaded other students from following this route.

In general, more students tended to skip exams as the semester progressed. This appeared to be related to other personal and academic stresses as the term moved along.

Consequences of student choices were a bit mixed, as one might expect. The four students exempted from the final were quite pleased with their situations. Three students failed to complete their minimum paper assignments, and so were given a zero for the missing paper(s); those students were obviously disappointed. Student satisfaction seemed to be relatively high, based on a large number of volunteered comments on both mid-term and end-of-term course evaluations. A few students felt that the grading options enabled them to procrastinate, and were critical of the instructor for providing that apparently irresistible temptation. Specific student comments were:

> *I really liked the grading setup. It was a great relief, especially during dead week, to know that I was not going to have to take another final.*
>
> *Grading setup was very liberal and fair.*
>
> *I like this grading system. I do better on tests than on writing so I didn't have to write the 3rd paper.*
>
> *Grading setup was wonderful. Allowed greater flexibility in my schedule. Appreciated having the choices.*
>
> *I thought the grading system was excellent. It gave the students a choice of how their grade was determined.*

Instructor satisfaction with the grading system was also high. A key benefit was that the instructor no longer had to grade as many half-hearted efforts on papers. For example, only 34% of the class attempted Paper 3. Under the previous grading scenario (all students did all papers and tests), the instructor would have been scoring far more papers near the end of the term.

This approach was a bit more difficult for the instructor to manage because explanations of grading options had to be more frequent and final grade calculation was a good deal more complicated. The instructor made a file copy of the original grade spreadsheet, then carefully moved through each student's scores, dropped the lowest ones, and then recalculated their grade standing.

Overall, the instructor was quite pleased with student responses. It was his intention to treat students as adults, offering them choices with attractive possibilities, and allowing them to live with the consequences of their choices.

SUMMARY

We believe that by giving students multiple opportunities, it sent the message to the students that our primary role was to help them learn, not to assign a grade. The motivation for adopting an options-based grading was not to encourage learning-based goals, but to (i) accommodate the students with contrasting expectations for the course, (ii) give the students more control over how they were evaluated in the course, and (iii) encourage students to take greater responsibility for their own learning. The thought was that by allowing students to choose how they will be evaluated it would allow students to work to-

ward their own strengths and make choices relative to their goals. For example, for students who adopted a performance goal in PLS 366, they could complete the homework assignments and, if their goal was met with their homework grades they could choose to skip the exam. Conversely, for students who adopted a learning goal, they could use the feedback that they received on the homework assignments to further guide their learning in preparation for the exam. In adopting options-based grading systems we hoped that we could accommodate the needs of students with both types of goals.

It is clear, though, that many students did not take full advantage of the opportunities to maximize learning and/or course grades available through this options-based grading system. We cannot draw any conclusions about student learning under our options-based grading system relative to a more traditional approach. Of interest in our findings is seeing, when given choices, what students choose to do and the results of these choices. This is especially true if these choices are seen to reflect students' attitudes. It is one thing for a student to say that they are motivated to learn in a course (e.g., in anonymous questionnaires or student surveys); however, when put in a position to either take a less than perfect score or spend additional time and effort to improve their course grade, many students chose not to expend additional effort.

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