RESEARCH

The Effect of Various Grading Scales on Student Grade Point Averages

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Objective. To investigate changes in and the impact of grading scales from 2005 to 2010 and explore pharmacy faculty and student perceptions of whole-letter and plus/minus grading scales on cumulative grade point averages (GPAs) in required courses.

Methods. Grading scales used in 2010 at the University of Cincinnati College of Pharmacy were retrospectively identified and compared to those used in 2005. Mean GPA was calculated using a whole-letter grading scale and a plus/minus grading scale to determine the impact of scales on GPA. Faculty members and students were surveyed regarding their perceptions of plus/minus grading.

Results. Nine unique grading scales were used throughout the curriculum, including plus/minus (64%) and whole-letter (21%) grading scales. From 2005 to 2010 there was transition from use of predominantly whole-letter scales to plus/minus grading scales. The type of grading scale used did not affect the mean cumulative GPA. Students preferred use of a plus-only grading scale while faculty members preferred use of a plus/minus grading scale.

Conclusions. The transition from whole-letter grading to plus/minus grading in courses from 2005 to 2010 reflects pharmacy faculty members' perception that plus/minus grading allows for better differentiation between students' performances.

Keywords: grading, grade point average, assessment

INTRODUCTION

Students' performance in an academic program is determined by the final grades they achieve in required courses. These grades result from the course instructor assigning a letter or number grade to summarize all evaluations of a student's performance during the course. Among other things, grades are used by pharmacy programs to evaluate applicants for postgraduate training and by prospective employers when considering job applicants; thus, the scale used to assign grades is exceptionally important.

Grades are commonly assigned using 1 of 3 methods: a traditional, whole-letter grading scale, a plus/minus grading scale, or a pass/fail scale. Plus/minus grading has been debated extensively over the last 20 years in the United States; US universities using plus/minus grading scales increased from 24% in 1982 to 56% in 2002.¹ However, the type of grading scale used in doctor of pharmacy (PharmD) curricula, the impact of this scale on

student performance and motivation, and student and faculty perception of grading scales have not been reported in the pharmacy education literature.

Justification for the transition to plus/minus grading has been discussed in other education literature.²⁻⁷ A key reason for the use of plus/minus grading is increased student differentiation. When assigning a final grade at the end of a course, the final percentage achieved by each student is converted to a letter, masking any difference in the final score achieved by students within the same letter grade range. If the final grade achieved by 2 students is the same, this implies equal performance. However, this depiction of equal performance may be misleading if one student achieved a percentage grade that was at the top of a letter grade range while a second student achieved a percentage grade that was at the bottom of the range for the same letter grade (eg, 89% vs. 81%). Decreasing the range between letter grades with plus/minus grading results in less distortion of and finer distinctions about students' performance.^{2,3} Central to this reasoning, however, are the assumptions that a difference of 2 to 3 percentage points signifies a meaningful difference in performance and that faculty assessments can accurately differentiate between these levels of performance.^{4,5}

In the literature on grading scales, the impact of plus/minus grading on GPA is conflicting; thus, this investigation

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was conducted to determine the impact of plus/minus grading within a PharmD curriculum. Until 2005, the University of Cincinnati Winkle College of Pharmacy predominantly used whole-letter grading scales for assessment of student performance. As part of the Accreditation Council for Pharmacy Education (ACPE) self-study in 2005, we examined students' mean GPA and realized there was little variability in GPA among students, especially in the first year. Although these issues were discussed informally among administrators and faculty members, a wide, formal evaluation of grading scales was not performed. We decided to perform a retrospective examination of grading scales used at the college and evaluate the impact of plus/minus grading on student GPA, as knowledge about this impact is essential to pharmacy programs throughout the country to ensure optimal grading of PharmD students and fair depiction of student performance to future employers and postgraduate training program directors. Specifically, our objectives were to (1) explore grading scales used in required classroom lecture-based PharmD courses, (2) determine the evolution of grading scales used at the college between 2005 and 2010, (3) evaluate the impact of whole-letter and plus/minus grading scales on course and cumulative GPAs, and (4) explore faculty and student perception of whole-letter and plus/minus grading scales.

METHODS

Course directors of the 31 required courses in the PharmD curriculum at Winkle College of Pharmacy were asked by e-mail to submit the grading scale they used to assess student performance in the most recent section of their course. After 1 week, a second e-mail was sent to those directors who had not responded. A third e-mail was sent to nonresponders 1 month after the first one. Courses for which a grading scale was not received after the third e-mail were omitted from the study.

From informal discussions among faculty members about the need for increased ability to differentiate between students' performances throughout the curriculum, we hypothesized that a transition from predominantly whole-letter grading in 2005 to plus/minus grading in 2010 had taken place. To quantify this transition, we compared grading scales used in courses in 2005 with those used in 2010 as determined by reviewing the course syllabi. Of the 31 required courses, 25 were taught in 2005 and grading scales were available for 21 of the courses. Courses were considered more differentiated if the grading scale used for them had changed from a whole-letter or a plus-only grading scale to a plus/minus grading scale and less differentiated if the grading scale used had changed from a plus-only or a plus/minus grading scale to a whole-letter grading scale.

Course directors of the 31 required courses in the PharmD curriculum were e-mailed to obtain individual student final percentage grades from the most recent offering of their course. Only the students' grades and not their names were provided so that the students' identities remained anonymous. The final grade percentages were then retrospectively assigned grades using the whole-letter grading scale and plus/minus grading scale shown in Table 1. Mean course GPA was calculated for each of the required courses in order to determine the impact of a whole-letter grading scale versus a plus/minus grading scale on student GPA. The impact of each grading scale on mean GPA for courses with a mean GPA above and below 3.0 (ie, more difficult and less difficult) was assessed to determine whether the impact of grading scale on courses generally considered to be difficult was different than that on courses considered to be less difficult. A breakpoint of 3.0 was used because it separates the letter grades B and C with achievement of a B generally considered acceptable mastery of content in graduate education programs. Additionally, a cumulative GPA for the entire PharmD curriculum was calculated using both scales.

A survey instrument was developed to ascertain faculty and student perceptions of grading scales and their association to fairness, student motivation, and ability to differentiate among levels of student performance. Faculty members and students in each of the 4 classes were surveyed about their perception of plus/minus grading using a personal response system at the beginning of a faculty meeting and at the beginning of a required course, respectively.

Descriptive statistics were used to summarize frequencies and means. The chi-square test was used to

Table 1. University of Cincinnati Grading Scales

Percentage GPA	Letter Grade	GPA Points Assigned
Plus/Minus Grading Scale		
93-100	A	4.0
90-92	A-	3.7
87-89	B+	3.3
83-86	B	3.0
80-82	B-	2.7
76-79	C+	2.3
70-75	C	2.0
<70	F	0
Whole-letter Grading Scale		
90-100	A	4.0
80-89	B	3.0
70-79	C	2.0
<70	F	0

compare grading scales from 2005 and 2010. Student *t* test was used to compare mean GPA of courses when whole-letter grading scale was applied to raw data versus when a plus/minus grading scale was used. The a priori alpha level was 0.05. Statistical analysis was performed using SPSS Statistics 18.0 (IBM, Chicago, IL).

RESULTS

Grading scales were obtained from 28 of the 31 (90%) required courses in the PharmD curriculum. Among the 28 required courses, 9 unique grading scales were used for assessment. Specifically, 18 courses used a variation of plus/minus grading, 6 courses used whole-letter grading, and 4 courses used a variation of plus-only grading. The University of Cincinnati's traditional whole-letter grading scale was used in 6 courses and university's plus/minus grading scale was used in 13 courses (Table 1). Differences in the plus/minus grading scales used throughout the curriculum included differences in the final percentage grades used to determine whether a plus or minus was added to the letter grade.

Grading scales used in 2005 were compared to those used in 2010. Of the 28 required courses for which 2010 data were available, 25 had been offered in 2005, but data were available for only 21. In 2005, 13 (62%) of the 21 courses were graded on a whole-letter grading scale compared to just 6 (21%) of the 28 courses in 2010 ($p = 0.004$) (Table 2). Conversely, in 2005, 4 (19%) courses were graded on a plus/minus grading scale compared to 18 (64%) courses in 2010 ($p = 0.002$). In 2005 and 2010, 4 courses in the required curriculum were graded on a plus-only scale ($p = 0.66$). When comparing grading scales used in 2005 to scales used in 2010, 9 (43%) courses became more differentiated and 1 (5%) course became less differentiated.

Individual students' final percentage grades were obtained for 25 of the 31 (81%) required courses taught in 2010. These final percentage grades were converted to GPA based on GPA points associated with the university's plus/minus and whole-letter grading scales (Table 1). When compared to a whole-letter grading scale, use of

a plus/minus grading scale led to an increase in mean GPA for 3 courses (Table 3), a decrease in mean GPA for 4 courses (Table 4), and the exact same GPA for 1 course. For courses with a mean GPA above 3.0, GPA with plus/minus grading was 3.4 compared to 3.5 on a whole-letter grading scale ($p = 0.07$). For courses with a mean GPA below 3.0, mean GPA on a plus/minus grading scale was 2.7 and 2.7 on a whole-letter grading scale ($p = 0.01$). The average cumulative GPA for the curriculum was equal on the plus/minus and whole-letter grading scales at 3.2.

Twenty-four faculty members (69%) and 351 students (92%) participated in a survey of their grading preferences using a personal response system (ie, clickers). Students preferred use of a plus-only grading scale and faculty members preferred use of a plus/minus grading scale (Table 5). The majority of students (73.5%) also felt that a consistent grading scale should be used throughout the curriculum. When asked whether plus/minus grading led to better student differentiation, the majority of faculty members agreed or strongly agreed with this concept and none strongly disagreed (Table 6). Although the majority of students agreed that plus/minus grading leads to better student differentiation, there were 41% who disagreed (Table 6). Similarly, 90% of faculty members agreed with the importance of differentiating between a student grade of 81% and 89%. The majority of students (90.6%) disagreed or strongly disagreed that plus/minus grading increased their motivation to learn; however, they indicated that plus/minus grading would change the amount of effort put into studying for a final examination (Table 6). When asked about the impact of plus/minus grading on student GPA, 60% of students perceived a plus/minus grading scale would lower a student's cumulative GPA (Table 7). Faculty responses on this issue varied, as 44% believed plus/minus grading would lower student GPA and 44% believed it would have no effect on student GPA (Table 7). Finally, twice as many students indicated they were more likely to challenge their final grade when plus/minus grading was used compared to when whole-letter grading was used; however, for over 40% of students, the type of scale did not affect the likelihood of challenging a final grade (Table 7).

DISCUSSION

A review of grading practices in 28 required courses at the Winkle College of Pharmacy revealed the use of 9 different grading scales, with minor differences in a student's final course percentage grade determining whether the student received a plus or a minus after the letter grade. From 2005 to 2010, grading scales changed from the use of predominantly whole-letter grading scales to plus/minus grading scales, consistent with the evolution

Table 2. Transition from Whole-letter Grading in 2005 to Plus/Minus Grading in 2010

Type of Scale	2005	2010	<i>p</i>
	21 Courses, No. (%)	28 Courses, No. (%) ^a	
Whole-letter scale	13 (62)	6 (21)	0.004
Plus/minus scale	4 (19)	18 (64)	0.002
Plus-only scale	4 (19)	4 (14)	0.66

^a Due to rounding, numbers do not equal 100%.

Table 3. Courses With an Increase in Mean GPA With Plus/Minus Grading

Course	GPA Calculated Using Whole-Letter Grading Scale ^a	GPA Calculated Using Plus/Minus Grading Scale ^a	Difference ^a	P
Renal Therapeutics	2.5	2.6	0.1	0.004
GI Therapeutics	2.8	2.9	0.1	0.026
Drug Delivery 1	2.7	2.7	0.1	0.020
Cardiovascular Therapeutics	2.6	2.7	0	0.109
CNS Therapeutics	2.9	2.9	0	0.304
Oncology Therapeutics	2.6	2.7	0	0.200
Pharmacoeconomics	3.0	3.1	0	0.320
Medicinal Chemistry	3.0	3.0	0	0.389
Skills Development 1	3.4	3.4	0	0.914

^a Numbers after rounding.

in grading methods reported by other universities around the country.¹

In this study, there was no difference between the mean cumulative GPA calculated using a plus/minus and that using a whole-letter grading scale. Similar results occurred in a Principles of Management course in which the GPAs of 944 students taking the course either before or after implementation of plus/minus grading were compared.⁶ Mean GPA on a whole-letter grading scale before and after implementation of plus/minus grading was 2.2 and 2.2, respectively. Despite no change in the average course GPA after implementation of plus/minus grading, the new grading scale did impact individual students' grades with 129 (13.7%) grades being increased, and 115 (12.2%) grades being decreased. Similarly, introduction of plus/minus grading at Richard Stockton College had little impact on mean GPAs for 3 courses; mean GPA on a whole-letter grading scale was 3.1 and mean GPA on a plus/minus grading scale was 3.1.⁷

Other studies have shown a change in mean GPA upon implementation of plus/minus grading. Mean GPA decreased by 19% among graduate students and 34% among undergraduate students at North Carolina State University after implementation of plus/minus grading.² Similarly, Dixon compared plus/minus grading with whole-letter grading in an Introduction to Programming course where students were given a choice between a plus/minus grading scale and whole-letter grading scale.⁸ Students who chose a plus/minus scale achieved a mean GPA of 2.5 compared with a mean GPA of 2.3 for those who chose a whole-letter grading scale. Interestingly, twice as many students chose the whole-letter grading scale versus the plus/minus scale, indicating student preference for use of a whole-letter grading scale. At Seton Hall University School of Business, GPA decreased immediately after implementation of plus/minus grading; however, GPA normalized to a value comparable to pre-implementation within a year of switching to the

Table 4. Courses With a Decrease in Mean GPA With Plus/Minus Grading

Class	Whole-letter GPA ^a	Plus/Minus GPA ^a	Difference ^a	P
Skills Development 3	3.5	3.4	0.1	<0.001
Endocrine Therapeutics	3.2	3.1	0.1	0.010
Longitudinal Patient Care	3.9	3.9	0.1	0.006
Skills Development 4	3.7	3.6	0.1	0.008
Skills Development 2	3.6	3.5	0	0.220
Pharmacy Management 1	3.4	3.3	0	0.243
Pharmacy Ethics	3.5	3.4	0	0.417
Pharmacy Management 2	3.7	3.7	0	0.208
Statistics for Pharmacists	3.4	3.4	0	0.449
Anatomy and Physiology	3.4	3.4	0	0.519
Drug Delivery 2	3.1	3.1	0	0.478
Introduction to Advanced Practice Experience	3.6	3.6	0	0.694
Pharmacy Jurisprudence	3.4	3.4	0	0.608
Molecular Biology	2.4	2.4	0	0.770
Pharmacology	2.6	2.6	0	0.677

^a Numbers after rounding.

Table 5. Faculty and Student Opinions Regarding Which Grading Scale Should Be Used at the Winkle College of Pharmacy, %

Respondents	Whole-Letter	Plus/ Minus	Plus Only	Pass/ Fail	Other
Faculty members (N = 24)	25	50	15	0	10
Students (N = 351)	17.5	15	48.3	18.3	0.8

new grading scale. The study investigators hypothesized that faculty members adjusted their grading practices to fit the new style of assessment and to improve student grades.

A previous study at the University of North Florida College of Business Administration compared mean GPA before and after implementation of a plus/minus scale and evaluated faculty and student perception of plus/minus grading.⁶ Overall, perception of plus/minus grading was negative; 58.6% of students believed plus/minus grading would decrease GPA. These results were almost identical to the 60% of students in our study who believed that plus/minus grading decreases GPA. Faculty members at the University of North Florida also viewed plus/minus grading negatively and felt it would decrease student GPA.⁶ The perceptions of faculty members surveyed in the present

study were more diverse, varying between the belief that plus/minus grading would decrease GPA and that it would have no effect on GPA. Additionally, students preferred use of a consistent grading scale throughout the curriculum, while more faculty members identified the importance of being able to differentiate between students' performance within the curriculum and believed use of plus/minus grading led to better student differentiation.

Although the results of this study indicated plus/minus grading has no impact on mean cumulative GPA, there may still be advantages and disadvantages to this type of assessment that warrant discussion. One potential advantage is an increase in student motivation. Student motivation is an imperative concern for pharmacy education stakeholders because it was correlated to improved student learning and increased comprehension of material.^{2,9} The literature

Table 6. Faculty (N = 24) and Student (N = 351) Perceptions of Grading Scales, %^a

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
Plus/minus grading leads to better student differentiation.				
Faculty	42	32	26	0
Student	17	43	27	14
I think it is important to differentiate between a grade of 81% and an 89%.				
Faculty	57	33	10	0
Student	30	36	25	9
Plus/minus grading is more fair than whole-letter grading.				
Faculty	43	24	33	0
Student	14	37	36	13
Plus/minus grading increases motivation to learn.				
Faculty	15	25	50	10
Student	2	7	44	46
At the end of the quarter, prior to the final examination, you have earned an 84%. Your effort in studying for the final examination may vary based on whether the grading scale is whole-letter grading or plus/minus.				
Student	30	29	25	16
If there is a limited possibility that I can increase my grade to the next letter grade, I will put in less time studying.				
Student	37	33	24	6

^a Due to rounding, numbers do not equal 100%.

Table 7. Faculty and Student Perceptions Regarding the Impact of Grading Scales on a Student's Cumulative Grade Point Average, %

Respondent	Lowest Student GPA	No Effect on Student GPA	Increases Student GPA
Faculty (N = 24)	44	44	12
Student (N = 351)	60	21	19

Abbreviations: GPA = grade point average.

about the effect of a plus/minus grading system on student motivation is conflicting.^{2,10,11} One study indicated students choosing to be assessed using plus/minus grading had no difference in achievement compared to those who chose to be graded using a whole-letter grading scale; authors of this study correlated this to no increase in student motivation.¹¹ Theoretically, however, a plus/minus scale motivates students to put forth more effort on assignments and the final examination because performance on the examination could more easily increase or decrease the student's final letter grade. Often, on a whole-letter grading scale, there is a point in the quarter where it is mathematically impossible to achieve a higher or lower letter grade, but because there are smaller increments between final marks on a plus/minus grading scale, the time in which a student could improve his or her course grade is longer.^{2,10} Lengthening this time period may motivate students to exert extra effort at the end of the semester, possibly increasing the amount of knowledge learned.^{2,10}

When asked about the impact of plus/minus grading on motivation to learn, students in our study indicated this type of assessment has no impact on motivation. Despite their perception of no impact upon motivation to learn, students indicated their effort in studying for a final examination may vary based on the grading scale used for assessment. Plus/minus grading may also be considered more fair because it is better able to discriminate between different levels of achievement, thereby increasing student motivation for achievement.¹⁰

In addition to increasing student motivation, plus/minus grading may decrease grade inflation.^{2,3,12} Definitions of grade inflation include an increase in grades not accompanied by an increase in academic performance¹⁰ or the reduced validity of grades due to a large distribution of A's and B's.² In 1992, the American Association of College Registrar and Admission Offices reported that grade inflation is a problem in higher education.^{1,2} Moreover, it was argued this problem could devalue the work of exceptional students.^{1,2} A study at the University of Arkansas College of Pharmacy indicated overall mean GPA increased by 0.9% per year from 1982 to 2002.⁵ This increase in mean GPA did not correlate with

higher preprofessional GPA or Pharmacy College Admission Test scores, indicating the increase in GPA resulted from grade inflation. Similarly, a second study in the pharmacy education literature recognized the need to decrease grade inflation caused by advanced pharmacy practice experiences (APPE) and worked to decrease this inflation using new APPE assessment instruments.¹² Data from a study involving Washington State University, North Carolina State University, and Berry College, showed that use of a plus/minus grading scale decreased the common inflation in GPA of 1% per year, suggesting a corresponding decrease in grade inflation.²

A possible disadvantage of the use of plus/minus grading is the potential increase in students who want to negotiate for the next increase in letter grade. Twice as many students in this survey indicated they were more likely to challenge their final letter grade if plus/minus grading were used for assessment rather than a whole-letter grading scale. Likewise, adoption of plus/minus grading at Washington State doubled the number of grade changes made by faculty members after submission of grades.⁸ However, it is not certain whether this was due to issues with faculty members adapting to the new scale or an increase in grade appeals by students.

Additionally, some have indicated a plus/minus scale is detrimental to high performing students.^{1,2} Students who would receive an A on a whole-letter grading scale could possibly earn an A- on a plus/minus scale, with no possibility of receiving an A+. Thus, a plus/minus scale could only decrease the potential GPA points of high-performing students. Previous studies indicated that 18% to 67% of undergraduate grades of A on a whole-letter grading scale would be an A- on a plus/minus grading scale, and the number of students graduating with a 4.0 GPA would decrease from 844 to 580 with implementation of a plus/minus grading scale.^{2,4} Conversely, the plus/minus system can benefit students with a GPA of 4.0 by increasing the value required to receive an A, making a high GPA more extraordinary.

This study has several limitations. Because the impact of a plus/minus grading scale on student GPA was calculated retrospectively, impact on student motivation, effort, and performance could not be quantified. Instead, students and faculty members were surveyed about their perception of plus/minus grading. Similarly, faculty members may have numerically adjusted their grades based on the scale used in their course. Thus, any differences in student GPA based on the scale used may have been masked before we received the data. For example, if course directors who used a whole-letter grading scale bumped borderline students up to the next highest letter grade, then use of a plus/minus grading scale might decrease mean

GPA; however, this could have been missed in this retrospective study. Finally, given that all grade data in this study was anonymous, the effect of plus/minus grading on the top 20% of students or students with mostly A grades could not be determined.

CONCLUSION

Despite a lack of formal evaluation of grading procedures at the Winkle College of Pharmacy, many courses evolved from use of whole-letter grading scales to plus/minus grading scales over a 5-year period. This transition occurred because most faculty members believed plus/minus grading would result in better student differentiation. This transition led to significant variability in grading scales used. Although most faculty members and students believed implementation of plus/minus grading would decrease GPA, our study showed no difference in cumulative-mean GPA when calculated using retrospective application of plus/minus and whole-letter grading scales. It is important for each institution to explore perceptions about grading scales and educate faculty members and students on any changes in grading scales used.

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