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Abstract

Past studies have explored student self-perception within chemistry courses. Various factors have been explored including course level, student academic background, and gender. However, it appears that there are few (if any) studies that have looked at whether students are aware of how they have performed previously in the course. Through a study over a two-year period, students at all levels (freshman through M.S.) of a chemistry program were surveyed and asked to self-report predictions of their score on examinations as well as several other items including their recall of previous course grades. At all levels, poorer performing students were less likely to be able to recall previous examination scores.

Introduction

Over the past few years, we have explored many factors in student self-awareness in chemistry courses. Much of the concern is that those who have poor self-awareness use it to make poor decisions which prevents them from improving their situation. Much of this stems from what has become known as "Kruger-Dunning effect," where participants were asked to predict their performance as well as their performance relative to others on various activities on grammar, logic, and humor (Kruger & Dunning 1999). They found that the highest performing participants possessed the metacognitive abilities that allowed them to accurately understand their own abilities, thus reporting more accurate predictions. Kruger & Dunning also concluded that lower performers tended to: "reach erroneous conclusions and make unfortunate choices, (exhibiting an) incompetence (that) robs them of the ability to realize it (Kruger & Dunning 1999)." While these studies were largely in non-academic settings, they did argue for the utility of the work in the realm of education (Kruger & Dunning 1999).

Initially, studies of the Kruger-Dunning effect predominated the field of psychology (Ehrlinger & Dunning 2003). Limited study was also explored in geography (Grimes 2002), statistics (Jordan 2007), biology (Bowers, et al. 2005), geology (Wirth & Perkins 2014), economics (Grimes 2002), and pharmacy (Austin & Gregory 2007). In the realm of chemistry, little work was done until recently (Potgeiter, et al. 2010; Bell & Volckmann, 2011; Pazicni & Bauer, 2014; Karatjas 2013; Karatjas & Webb 2015, Karatjas & Webb, 2018). Another publication in the area (Kuncel et al 2005) did a meta-analysis of self-reported grades and found that self-reported grades were highly dependent on both level of performance as well as cognitive ability. Their study focused on overall course grades

and overall student GPA.

With our previous work in student self-perception, we began to explore additional aspects of student self-awareness. How well do students recall their recent examinations? As with examination score predictions, students that are unable to recall previous performance will have less incentive to take the steps needed to improve their course performance. This leads to some fundamental questions related to exam score recall that we wanted to explore: How many students have no recall as to how they previously performed? How accurate are their examination memories? Are there differences based on course level or grade level? In most chemistry courses, exams make up the overwhelming potion of the lecture grade. Therefore, it would be expected that these chemistry examinations are major course events where knowledge of one's own performance is important.

Most previous research regarding memory of past activities suggests that positive memories are more strongly recalled than negative memories (Adler & Pansky 2020). It is suggested that the primary reasons for this are self-protection and self-enhancement (Sedikides, 2020). Cole and Gonyea found that self-reporting of SAT and ACT scores often had poor accuracy and that lower performing students often were much less accurate (Cole & Gonyea 2010). Bahrick et al. (Bahrick et al. 1996) looked extensively at high school grades recalled by college students. They found that as student grades went down, accurate recall also went down. However, their study does not look extensively at lower performing students as more than 97% of the grades in their study were a C or higher. The majority of these previous studies looked at long range events as opposed to short term events within a course. Would the same issues be apparent just a few weeks later within a course?

This work is the only work that we know of that looks at student perception and prediction at multiple course levels: freshman, sophomore, junior, senior and graduate level courses. We were interested to see if the previous trends on grade recall stayed consistent through all levels of chemistry courses, or if the effect lessened as the worst performing students (in the lower level courses) were no longer part of the population in the higher-level courses. In addition, we wanted to study this effect in the context of a field that is reputed to be difficult (i. e., would chemistry be perceived differently than other fields). Finally, we wanted to further explore student examination grade recall for the following reason: Students' own perception of how they are currently performing in the course could play a significant role in their decisions for how they prepare for future work in the course. Student that do not recall that they are doing poorly in the course may not realize that there are issues that they need to improve upon for future studies. Logically, one would expect that if students do not recall their past performance, they would find no reason to change their study habits (or to fix their examination preparation) until it is too late.

Method

This study is a comprehensive, large scale study of undergraduate/graduate chemistry courses including: 100-level, General Chemistry I, General Chemistry II, Chemistry in Contemporary Issues (populated by non-science majors), Crime Scene Chemistry (populated by non-science majors), and Principles and Application of General, Organic, and Biochemistry (populated by nursing students) which primarily focuses on organic chemistry; 200-

level: Organic Chemistry I, Organic Chemistry II, and Quantitative Analysis; 300-level: Physical Chemistry I, Physical Chemistry II, and Environmental Chemistry; 400-level: Biochemistry I, Biochemistry II, Chemical Hazards and Laboratory Safety, Instrumental Methods, and Medicinal Chemistry; and 500-level: (Masters-level): Advanced Organic Chemistry, Advanced Physical Chemistry, and Advanced Analytical Chemistry.

After receiving IRB approval, the authors solicited professors teaching lectures in all courses in a state university chemistry department. Students at this university come from a variety of backgrounds with some never having taken a chemistry course prior to the courses involved in this study. However, in order to advance to upper level courses, students are required to have at least a passing grade (D^-) in the prerequisite course(s). Students that were willing to participate were asked to sign a consent form before participating in the study. Overall participation in the study was found to be approximately 80% of students in most courses, but a more exact number is harder to discern due to items such as student withdrawals, etc. Instructors and students were given instructions on how to fill out a short survey prior to starting the exam. Professors were asked to staple surveys to the front of each exam in order to help assure that the data collected were an exam prediction and not a postdiction (prediction done after the exam is complete) and instructions were given to complete the survey prior to starting the examination.

The survey (see Figure 1) consisted of some demographic data, name, major, etc., as well as several additional questions.

Chemistry Grade Perception Survey 2014

Addendum to Exam 2:

Name: _____

Course / Sec.: _____

Major: _____

Exam # _____

1. When did you start preparing for this exam? (Circle ONE option)

Greater than 7 days Less than 7 days Less than 1 day Other _____

2. Which of the following "tools" assisted your studying the most? (Please Circle **ONE** option)

- Textbook
- Homework / Problem Sets
- Class Notes
- Old Exams
- Any Tutoring Service
- Quizzes

3. What score (out of 100) do you anticipate on this exam? _____

4. What score (out of 100) did you earn on your previous exam? _____

5. What grade range do you anticipate you will achieve at the end of the semester in this course? (Circle ONE option)

A B C D F

Return of this survey indicates my consent to have my data used in this research.

Figure 1. Sample Survey

Data were collected over a one and one-half year period (Spring 2013, Summer 2013, Fall 2013, and Spring 2014) throughout the entire chemistry program at the university in the study. While the authors are continuing to look at data from the other questions, the focus of this study is the student answers from question #4. Accuracy of student grade recall was found by subtracting their actual examination grade from their recalled examination grade. Therefore, a positive difference indicates that they recalled a higher grade than they actually earned and a negative difference recalls a lower grade. Recall of exam 1 grade was surveyed at the start of exam 2, recall of exam 2 grades were recalled at the start of exam 3, and recall of exam 3 grades were recalled either at the start of exam 4 or the final exam (for courses without a fourth in-semester exam). Statistical analysis performed used a single factor ANOVA as well as t-Tests: Paired Two Sample assuming Unequal Variances with an alpha value of 0.05.

Results

For the purposes of this analysis examinations were grouped in two possible ways: either by exam (exam 1 vs. exam 2 vs. exam 3), or with all examinations grouped together but broken up by exam score. Final examinations were excluded from the data analysis for consistency and because of the inherent difficulty in collecting post-final examination data collection. For each course level (100, 200, 300, 400, & 500-level), the students were grouped by their examination grade. First, we looked at the group of students that did not have any recall of their previous examination grade. This data set included students that gave these answers such as: “I don’t know,” “no idea,” “bad,” “good,” “better,” as well as students that left the grade recall question blank but completed all other questions on the survey. This data is reported in Table 1. The first number in each entry is the percentage of students that did not recall what their previous exam score was as described above. The second entry is the total sample size for that group of students (i.e. there were 650 completed student surveys that asked students if they recalled their score for exam 1 in 100-Level courses. Of those 650 students, 7.4% (or 48 students) did not recall their score as described previously).

Table 1. Percentage of Students that Did Not Recall Their Examination Score

Group of Students (%, N)	100-Level	200-Level	300-Level	400-Level	All
Exam 1	7.4%, 650	5%, 100	8.3%, 36	7.2%, 69	7.1%, 874
Exam 2	11.6%, 545	5.3%, 133	4.5%, 22	10%, 50	10%, 750
Exam 3	14.9%, 309	11.3%, 124	11.1%, 27	7.7%, 13	13.5%, 473
All Exams	10.4%, 1504	8.1%, 393	8.2%, 85	8.3%, 132	9.7%, 2133

Table 2 compares the average exam score of those students that did not recall their examination grade to the average as a whole. The difference of means is the difference in the average exam score for all students and the exam score for students that did not recall their exam scores. Next, we looked at the means of their recalled exam grades versus the actual examination grade and analyzed the difference. The differences were calculated using the students’ recalled grade and subtracting their actual grade. This data does not include those students previously discussed above that did not give numerical answers to this question. Positive values were the result of students

recalling a higher grade than their earned grade. These calculated differences were examined by course-level, student exam grade, and over time.

Table 2. Comparison of Students that Did Not Recall Their Previous Exam to Course Averages

Exam	Average score of students that did not recall exam score (N)	Average exam score of all students (N)	Difference of means
Exam 1	56.5% (62)	72.9% (874)	16.4%
Exam 2	50.6% (75)	69.2% (750)	18.6%
Exam 3	61.1% (64)	72.5% (473)	11.4%
All Exams	56.2% (207)	71.5% (2133)	15.3%

Table 3 shows the data for all 1926 examinations that had a numerical answer to question 4 on the surveys. (On average approximately 80% of students completed at least one examination survey in each course. Here, the data are broken up by course-level and over time (Exam 1 vs. Exam 2 vs. Exam 3). The data here indicates raw score – for example, 100-Level students recalling exam one, recalled, on average scores that were 0.39 points (out of 100) higher than the actual examination scores. Most courses had higher completion rates, but exact values are difficult to calculate based on items such as when students withdrew from courses, etc. Please note that in several tables, the total N appears to be greater than the sum of the columns because it may include sample sizes that were too small to include as individual entries, such as a small number of courses that held a 4th semester exam or 500-Level course data.

Table 3. Comparison of Student Recall by Examination

Exam (Recall – Actual), N	100-Level	200-Level	300-Level	400-Level	All Students
Exam 1	0.39, 602	1.37, 95	1.09, 33	-1.30, 64	0.39, 812
Exam 2	0.96, 482	-0.18, 126	1.07, 21	0.23, 45	0.70, 675
Exam 3	0.64, 263	-0.38, 110	0.87, 24	-1.30, 12	0.32, 409

The standard deviation for each of these groups can be found in Table 4.

Table 4. Standard Deviations for Comparisons of Student Recall to Actual Performance by Course Level

Exam	100-Level	200-Level	300-Level	400-Level	All Students
Exam 1	4.16	2.60	3.32	3.88	3.95
Exam 2	5.81	6.73	3.09	5.84	5.94
Exam 3	9.69	3.53	8.57	12.21	8.44
All Exams	6.18	4.73	5.39	5.88	5.86

Table 5 looks at the differences with students categorized by examination score (students who scored >90, students who scored between 80-89, etc). The difference displayed takes the score that students recalled and subtracts the score (out of 100) that they earned. A negative value indicates that they recalled a score lower than what they actually earned while a positive value indicates that they recalled a grade higher than what they had received. For

example, students scoring below 60% in 100-Level courses on average recalled a score that was 2.95 points (out of 100) higher than their actual scores.

Table 5. Comparison of Recall to Actual Scores by Exam Performance

Group of Students (Recall – Actual), N	100-Level	200-Level	300-Level	400-Level	All
> 90%	-0.50, 249	-0.91, 45	-0.55, 18	-2.34, 15	-0.31, 660
80-89%	-0.13, 292	-0.39, 70	0.29, 22	-1.67, 36	-0.15, 846
70-79%	-0.44, 260	-0.46, 85	0.42, 17	-0.58, 40	-0.21, 807
60-69%	1.12, 273	1.51, 70	0.50, 7	1.87, 20	0.61, 742
< 60%	2.95, 332	1.53, 100	5.15, 14	-0.85, 10	1.31, 913

The data in Table 6 shows the standard deviations for each of the groups explored in Table 5.

Table 6. Standard Deviation of Recall to Actual Scores by Exam Performance

Group of Students	100-Level	200-Level	300-Level	400-Level	All
> 90%	3.33	3.94	4.55	6.94	3.63
80-89%	3.80	3.34	4.03	5.01	3.86
70-79%	5.69	5.84	3.92	5.41	5.60
60-69%	4.86	4.30	0.76	8.28	4.95
< 60%	9.28	4.76	8.72	3.92	8.41

The next two tables explore the students in our data set that successfully recalled their previous exam grades correctly. Table 7 looks at students with exact recall on each exam while Table 8 explores the percentage of students with exact recall based on their earned examination grades.

Table 7. Percentage of Students that Recalled Their Exact Exam Score

Exam %, N	100-Level	200-Level	300-Level	400-Level	All Students
Exam 1	56.1%, 602	57.9%, 95	60.6%, 33	65.6%, 64	57.9%, 812
Exam 2	57.1%, 482	48.4%, 126	52.4%, 21	46.7%, 45	54.5%, 675
Exam 3	51.0%, 263	58.2%, 110	37.5%, 24	0%, 12	50.6%, 409
All Exams	55.5%, 1347	55.5%, 110	51.3%, 78	52.1%, 121	55.5%, 1926

Table 8. Percentage of Students that Recalled Their Exact Exam Score Based on Exam Grade

Group of Students (Recall – Actual), N	100-Level	200-Level	300-Level	400-Level	All
> 90%	81.1%, 249	75.6%, 45	44.4%, 18	53.3%, 15	77.2%, 333
80-89%	70.2%, 292	54.3%, 70	50%, 22	58.3%, 36	65.5%, 846
70-79%	61.1%, 260	57.6%, 85	70.6%, 17	55%, 40	60.5%, 807
60-69%	41.0%, 273	50%, 70	57.1%, 7	35%, 20	43%, 742
< 60%	42.1%, 332	46%, 100	35.7%, 14	40%, 10	42.9%, 913

Table 9 looks at the percentage of students that were off by more than a certain number of points. A student in the first column (10 or more points under) is a student that recalled a score more than 10 points lower than their actual grade, while the far right column (10 or more points over) indicates a student that recalled a grade more than 10 points higher than what they actually earned.

Table 9. Percentage of Students that Recalled More than a Given Number of Points from Actual Grade based on Exam Number

Exam %, N	10 or more points under	5 or more points under	5 or more points over	10 or more points over
Exam 1, 812	1.85% (15)	4.31% (35)	7.14% (58)	5.05% (41)
Exam 2, 675	1.93% (13)	5.19% (35)	9.19% (62)	4.74% (32)
Exam 3, 409	4.65% (19)	6.60% (27)	10.3% (42)	7.33% (30)
All Exams, 1926	2.49% (48)	5.09% (98)	8.46% (163)	5.40% (104)

Table 10 looks at a similar idea but sorts the students by their earned examination score.

Table 10. Percentage of Students that Recalled More than a Given Number of Points from Actual Grade Based on Exam Number

Group of Students (Recall – Actual), N	10 or more points under	5 or more points under	5 or more points over	10 or more points over
> 90%, 333	3.00% (10)	4.80 % (16)	0.90% (3)	0.03% (1)
80-89%, 846	1.18% (10)	2.48% (21)	1.77% (15)	2.36% (2)
70-79%, 807	1.86% (15)	3.47% (28)	2.48% (20)	0.87% (7)
60-69%, 742	0.81% (6)	1.75% (13)	5.26% (39)	2.29% (17)
< 60%, 913	0.77% (7)	2.30% (21)	9.53% (87)	5.81% (53)

Discussion

Overall, approximately 10% of the surveyed students reported no recall of their score on their previous examination despite having taken the previous examination. This included students that did not answer the question but completed all remaining questions on the survey or gave answers that said they did not know or were highly uncertain or gave vague, non-numerical answers. On average, the students that did not recall their recent examination score had examination scores that were about 15 points lower than students that gave a numerical answer to the question. Past work regarding items such as student examination predictions and postdictions have shown that over the duration of a course, student predictions generally improve (Hacker, et al., 2000). Surprisingly, the study results showed exactly the opposite trend. On their first exam, 7.1% of students did not have any recall of their previous grade. This increased to 10% for exam 2 and 13.5% for the third exam. When we split the data up by course level, this increase is even more clear in 100-level courses where the percentages double from exam 1 to exam 3. The same is also true for 200-level courses. A less clear trend was seen for 300-level and 400-level courses, however, this may be due to the small sample size at both levels.

Some similar types of trends are also seen when looking at the exam scores for this group of students. On average, students that did not recall their previous exam grade had an exam average of 56.3% compared to a 71.5% average for all students. Interestingly, the average score of students with no recall went up from the first exam to the third meaning that there were more of the better students who did not recall their score, but the gap was actually largest for exam 2. While the number of students that did not recall their grade over time went up, there was no clear trend in terms of the examination scores for this group of students. However, it is clear that it is primarily poorer performing students that do not recall their previous examination grade.

Overall, it is highly concerning that so many (~ 10%) of the students do not know what their current status in the course is. While instructors are constantly making attempts to reach out to poorer performing students, these efforts are less likely to be successful if students are unaware of their own standing. We next considered the remaining 90% of students that did report a score for what they got on their previous examination. We broke these students up in 3 ways, looking at course level, over time (exam 1 vs. exam 2 vs. exam 3), and exam score. Some of the same trends that we found for students that had no recall of their previous grade emerged here as well.

These data are found in Table 3 and Table 5. Overall, for the 1926 surveys completed here, on average, student recalls are relatively accurate. The average difference between the recalled grade and the actual grade is 0.48% on the examination. The standard deviation for this overall group of students was found to be 5.86%. While the standard deviation here is much larger than the average difference, this is not of concern. The average difference combines both negative and positive values, making it likely that a small value would be found here. However, some interesting trends can be seen over time. The average difference for the full group of students as well as for 100-Level and 400-Level reaches its highest point during exam 2. However, consistent with the fact that students had less knowledge of their exam grades as time went on is the fact that the range of responses increases significantly over time. The standard deviation for the first exam was just under 4% while increasing to over 8% for the third examination. Interestingly, students in 200-Level courses were the most accurate in recalling past performance with both the smallest mean as well as the smallest standard deviation. At the 400-Level, on average, students recalled a lower score than what they had actually earned by 0.73%.

All of the standard deviations for the groups in Table 3 and 5 can be found in Table 4 and 6. Much larger standard deviations can be found for poorer performing students compared to higher performing students. In addition, the largest amount of variance was found for exam 3. Perhaps, most surprising here was that the standard deviation went up over time (exam 3 > exam 2 > exam 1).

Finally, we considered how well students recalled their exact scores. When considering how many students were able to recall their exact exam score, similar trends to what was shown above was seen. On average just over half of the students were able to recall their exact exam score (Table 7). However, as with other data, it gets worse over time. Approximately 58% of students were able to recall their exam 1 score, but it was down to closer to 50% by exam 3. When looking at this by grades, the expected trend is seen – the highest performing students have a high overall recall (just under 80% of them recalled their exact grade), while only slightly over 40% of

students that failed were able to recall their exact grade. These trends seem to be independent of course level with the exceptions of some cases where the sample size is small.

We also expanded this type of recall to students that were more than 5 or 10 points from their exact score (Tables 9 and 10). First, we see that many more students recalled a higher grade (~ 14%) than a lower grade than what they actually earned (~7.5%). In addition, there were more inaccurate predictions for exam 3 versus exam 1. This is a reinforcement of this same trend that was seen in all other methods of analysis. In addition, as we look at grade groups, the expected trends were also repeated. For the highest performing students, only about 9% of students were off by more than 5 points in either direction. This increased as grades on the exams decreased to being just under 20% for students scoring under 60% on their exam.

Additional analysis was performed using T-tests on a number of different combinations of students. In Table 11, each set of possible examinations was considered at each course level plus a comparison of the entire group. In most cases, P values of greater than 0.05 were seen. The greatest variation is seen at the 200-Level, but for most comparisons explored here, data show that over time (exam 1 vs. exam 2 vs. exam 3), the variances are not found to be statistically different.

Table 11. P(T ≤ t) Two Tailed Values for Comparison of Examination Groups by Course Level

	Exam 1 vs. Exam 2	Exam 1 vs. Exam 3	Exam 2 vs. Exam 3
100-Level	0.07388	0.68859	0.63241
200-Level	0.02280	0.01621	0.48017
300-Level	0.98004	0.090460	0.91555
400-Level	0.12862	0.99371	0.67472
All Levels	0.24602	0.77887	0.68726

The next groups of comparisons were made between students at different levels by exams and for all exams. Here the comparison was between different course levels. At the comparison of most course levels, P-values greater than 0.05 were again seen. This shows there is very little difference in the variances based on course level. The smallest P-value is found for comparison of students with the 400-Level courses. In many of these comparisons, the P-value is less than 0.05 indicating that the 400-Level students for most exams are statistically different from the students at other course levels.

Table 12. P(T ≤ t) Two Tailed Values for Comparison of Course Level by Examination

	Exam 1	Exam 2	Exam 3	All Exams
1XX vs. 2XX	0.00214	0.09603	0.66129	0.43499
1XX vs. 3XX	0.25172	087417	0.90250	0.55434
1XX vs. 4XX	0.001469	0.42924	0.59106	0.01518
2XX vs. 3XX	0.67506	0.18418	0.76924	0.35708
2XX vs. 4XX	$4.89 * 10^{-6}$	0.72589	0.64556	0.05328
3XX vs. 4XX	0.00219	0.44797	0.58306	0.03200

In Table 13, we examine the P-values for course comparison broken by student grades. In almost every case, the P-values are above 0.05 indicating that based on grades, the populations at different course levels are not statistically different.

Table 13. P(T ≤ t) Two Tailed Values for Comparison of Course Level by Score Group

	> 90	80 – 89	70 – 79	60 – 69	< 60
1XX vs. 2XX	0.51507	0.57964	0.99172	0.23079	0.04197
1XX vs. 3XX	0.96657	0.63638	0.40306	0.55004	0.37261
1XX vs. 4XX	0.25309	0.08391	0.88278	0.56200	0.01503
2XX vs. 3XX	0.76710	0.47915	0.45029	0.09434	0.1503
2XX vs. 4XX	0.39749	0.17350	0.90342	0.84843	0.09883
3XX vs. 4XX	0.34710	0.10867	0.43749	0.47140	0.03498

Finally, we explored the T-tests based on comparison of different score groups. For groups of students with similar score ranges (e.g. 80 – 89 vs. > 90), the P-values typically show that the populations are not statistically different in the way that they recall their examination grades. However, when comparing grade groups of students with very different scores (e. g., <60 vs. > 90), the P-values indicate that the variances are different.

Table 14. P(T ≤ t) Two Tailed Values for Score Groups by Course Level

	100-Level	200-Level	300-Level	400-Level	All
80 – 89 vs. > 90	0.23817	0.46809	0.54782	0.70554	0.23068
70 – 79 vs. > 90	0.89611	0.59771	0.50513	0.32777	0.55018
60 – 69 vs. > 90	0.00146	0.00273	0.35885	0.08892	$3.25 * 10^{-6}$
50 – 59 vs. > 90	$1.00*10^{-9}$	0.00185	0.03975	0.45868	$6.12*10^{-13}$
70 -79 vs. 80 – 89	0.45937	0.93361	0.91928	0.36660	0.71343
60 – 69 vs. 80 – 89	0.02489	0.00429	0.81934	0.09244	0.00015
< 60 vs. 80 – 89	$5.04*10^{-8}$	0.00242	0.06746	0.59121	$5.14*10^{-11}$
60 – 69 vs. 70 -79	0.01291	0.01839	0.93776	0.23869	0.00038
< 60 vs. 70 – 79	$6.72*10^{-8}$	0.01362	0.07796	0.86015	$5.04*10^{-10}$
<60 vs. 60 – 69	0.00037	097338	0.06963	0.23124	0.00083

The two overall trends present very interesting situations. One of which is highly surprising. We did not expect that exam predictions would get worse over time – in fact, we expected the exact opposite to occur for two reasons. One, students may not have been expecting the question about recall on the second exam survey since it was not present on the first exam survey (since there is no previous examination to refer to at that time). Therefore, given that students would know that this question is being asked, we expected an increase in accuracy. In addition, some of the poorest performing students are no longer present by the end of the course due to various reasons (withdrawals, no longer showing up, etc…), and it might be expected that on average a better group of students would be the ones filling out the survey at this time.

The second trend, much more expected, is that poorer performing students have much worse recall of their recent performance. While it is unclear as to the reason for poorer performing students having less recall of their course grade the issue continues to be concerning. Much of the previous literature in psychology attributes most people to having better memories of positive events than negative events, suggesting that students block out or have false memories of how they performed on coursework. Universities currently invest a great deal of money and resources in systems such as Starfish Retention Solutions which are purported to facilitate reaching out to students by allowing instructors to provide both kudos for students that are doing things well and raising alerts for students that are struggling. These systems often come at great financial cost to the university (while cost data can be difficult to find for this software, as an example, Westchester Community College reported paying $174,900 for a three-year period (Westchester Community College, 2016)). Student performance is only likely to improve when a student recognizes their own deficiencies and gets the help that they need to improve. However, if memories are often enhanced due to the desire for self enhancement, then these systems may be unsuccessful in improving student performance.

Conclusions

In our study of student self-awareness, proper recall was a factor that we wanted to explore. As with our grade prediction study, if students do not have an accurate recall of their past performance, it may be hard to get them to do the work needed to improve, or to understand the need to improve. From this study, it is clear that higher performing students have more accurate recall of their past performance than poorer performing students. In addition, student recall of their previous exam seems to get worse throughout the duration of a course, which may be another factor revealing why struggling students have difficulty in improving.

Recommendations

The data presented here is somewhat concerning and speaks to a greater issue of students working obliviously in an ill-informed self-unaware state which makes it exponentially more difficult for a student to be successful in a challenging course such as chemistry. In order to rectify the students lack of awareness observed in this study, we feel it is vital that students are given the academic tools to look at their performance authentically, which will help give them the ability with which they can accurately assess whether they need to study more. This can start with some fairly old “memory tricks” which have largely been forgotten by the current generation of students (Lorayne & Lucas 1976). These tricks when applied will not only help their general studying in a difficult course like chemistry but also give students better tools to remember something as critical as their previous exams grades which will allow them to accurately gauge the study time required to improve in their coursework (Lorayne & Lucas 1976; Lorayne 2007). Additional academic metacognitive study skills to help students become more self-aware of their standing in a course may also help (McGuire & McGuire 2015).

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