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Surprises in the Muddy Waters of High-Enrollment Courses

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ABSTRACT: Based on a previous analysis of student reflection responses, we developed and implemented a hybrid reflection activity that allowed students to choose among a "Muddiest Point" prompt or a "Most Surprised" prompt, or to use both. We examined and coded student responses from two different courses and determined that each prompt elicits different responses and provides unique benefits. As the term progressed, student responses to the Muddiest Point prompt increased and responses to Most Surprised decreased. The Muddiest Point allows students to more directly express where they are struggling in the course, and it allows instructors to see what concepts are most confusing for students. Alternatively, many students used the Most Surprised prompt to express things that were helpful, or in some cases harmful, for their learning process. The affective quality of the response also differed based on the prompt students selected; Muddiest Point responses were more often negative whereas Most Surprised responses were frequently positive. We recommend the hybrid prompt and argue that in addition to providing information about what specific course material is problematic for students, the reflection activity provides information about course structure and teaching practice and can be a useful early formative course evaluation tool for instructors. Because many students use the reflection questions to submit suggestions for ways to improve the course, an instructor who regularly reviews responses can adjust the structure of the course or their teaching practice accordingly.

KEYWORDS: *First-Year Undergraduate/General, Chemical Education Research, Communication/Writing, Thermodynamics*

FEATURE: Chemical Education Research

INTRODUCTION AND BACKGROUND

Brief end-of-class activities where students reflect on the content that has just been covered by responding to a prompt provided by the instructor have been described as providing one of the best returns on investment of class time and instructor effort.[1] These activities are often termed the minute paper[1−3] or the exit slip.[4] Several different prompts have been used, including asking students to write about the aspect of class that they thought was the most important,[1,5] interesting,[6] confusing or muddiest,[1,5−11] or surprising.[7,12] However, there is scant comparative empirical evidence about the ways students respond to these prompts that would allow an instructor to make an informed choice about which prompt or sets of prompts to use.

The minute paper can serve two purposes. First, it encourages students to evaluate their own understanding of what they are learning and thereby develop metacognitive strategies characteristic of experts.[13,14] Second, it provides instructors formative information about what material is problematic for students. Thus, for both students and instructors, this type of activity fits within the definition of Turns and Atman of reflection as the act of "exploring the meaning of experiences and the consequences of the meanings for future action."[15]

In a previous study,[7] we compared two end-of-class reflection questions which we labeled Muddiest Point and Most Surprised. The Muddiest Point required the students to respond to the prompt, "What was the muddiest point in class this week?" whereas the Most Surprised activity asked students to answer the question "What surprised you most about class this week?" The Muddiest Point minute paper is common, and its use has been reported in a variety of university classrooms including chemistry,[2,11] biology,[6] statistics,[8] materials science,[9,10] aeronautics,[5] and chemical engineering.[16] While many of these studies report positive attitudes of instructors and students, only in a few instances is the use of minute papers correlated to retention or achievement data.[10] Moreover, analysis of the content of the student responses, when it is even done, is typically *ad hoc* rather than applying systematic qualitative methods. In contrast, Most Surprised activities are rarely used, and when used, they are typically included as one item of many such as part of the five-question critical incident questionnaire (CIQ).[12,17] And studies that explicitly investigate the use of the Most Surprised prompt in various settings are lacking.[18]

In the previous study,[7] we used a quasi-experimental design to examine students' in-class responses to these two exit questions where students were asked to reflect on the class over the last week. Each week, one section of students was given the Muddiest Point prompt while the alternate section was given the Most Surprised prompt. We concluded that there are benefits specific to each prompt. The Muddiest Point prompt is more familiar to students, and it easily allows them to directly express what course content is unclear. The Most Surprised prompt allows a wider range of responses. In this article, we report on our continued examination of student reflection responses through implementation of a hybrid prompt that allows students the opportunity to select Muddiest Point, Most Surprised, or both. This strategy provides greater authorship to the student. It also allows an alternative prompt to those

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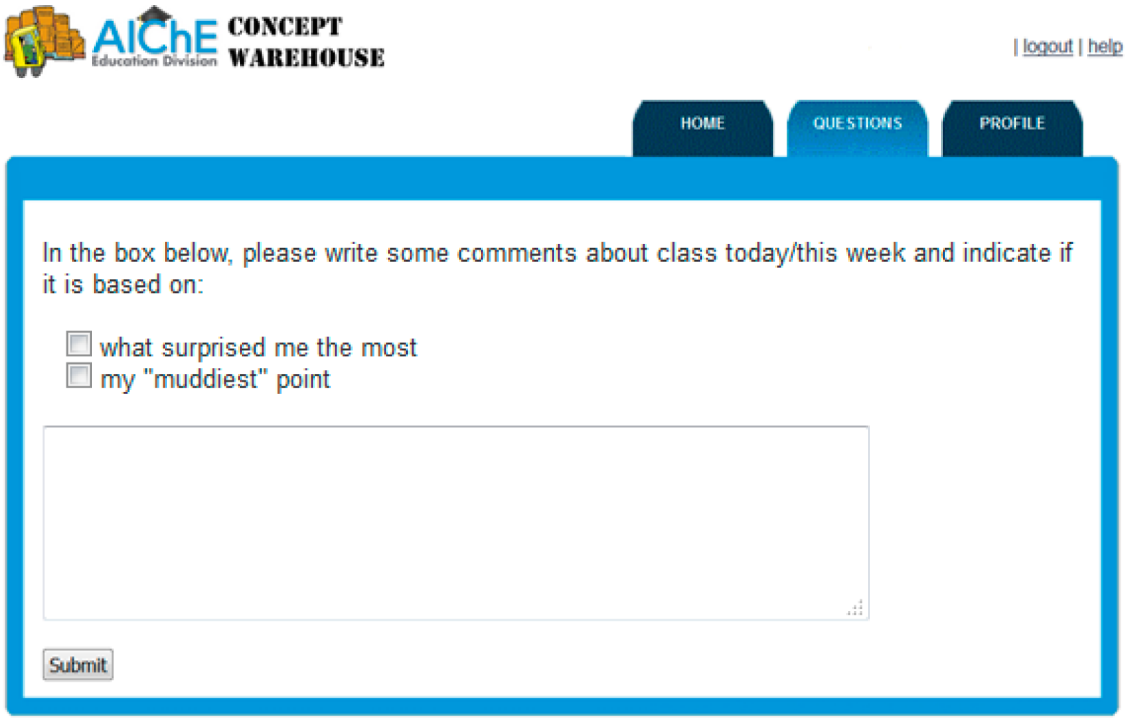

Figure 1. Hybrid prompt reflection activity used in this study (logo reprinted with permission from AIChE).

students who wish to express a positive outlook. If the class size is large enough, as are the cases studied here, we hypothesize that the instructor should have sufficient Muddiest Point responses to directly identify unclear and confusing content, but also see expressions of student success seen in Most Surprised.

In this research study, we analyze the implementation of the hybrid prompt in two different large courses (Process Analysis and Thermodynamics II) taught by different instructors. With this strand of research, we aim to provide two contributions to the chemistry education literature. The first aim addresses empirical research. While minute papers such as the Muddiest Point are commonly used in practice, systematic empirical investigations about how students respond to these types of questions in classroom settings are lacking. With our study design, we compare written student responses across courses taught by instructors with different levels of experience and where students have the option to respond to different prompts. Our goal in this analysis is not to provide a detailed categorization of the specific concepts and procedures with which students struggle in each course. Rather, borrowing form Wenger-Trayner and colleagues,[19] we seek to provide a view across the "landscape" of use in such reflection activities and thereby help instructors and researchers develop knowledge-ability. Second, we are interested in innovative instructional design and how the use of computer technologies supports flexible uses of pedagogical strategies in the classroom. In the context of the first aim, we address this aim by investigating student response data to our computer-enabled hybrid prompt.

To accomplish these aims, we ask the following research questions:

(RQ1) How frequently do students choose each type of prompt (Muddiest Point, Most Surprised, or both)? How do their choices tend to change during the term?

(RQ2) How does the type of reflection in the student responses differ based on the type of prompt that they choose? How does the type of reflection tend to change during the term?

(RQ3) Is there a difference in the affective quality of the responses for the Muddiest Point and Most Surprised prompts? How do instructors respond to the differences in affect?

METHODS

In this article, we report on student responses to a modified reflection prompt that provides more authorship to the student by allowing her/him to choose either reflection or both. This activity is available through the AIChE Concept Warehouse[20] and shown in Figure 1. We conducted the study at a large public university in the Northwest United States. Data are only reported for students who agreed to participate and signed an informed consent form approved by the Institutional Review Board.

Participants were enrolled in either a sophomore-level course in Process Analysis (Second (2nd) Year Course) or a junior-level course in Chemical Thermodynamics (Third (3rd) Year Course). Each course had approximately 200 students and was taught by a different instructor. These courses were chosen to compare student reflection in very different learning contexts. The content in the Second Year Course focused on interpretation of realistic data in terms of science principles, engineering decisions, and statistical variation. It was taught by an instructor with broad knowledge of active learning but with no previous lecture experience. The Third Year Course content focused on chemical thermodynamics including phase equilibria and chemical reaction equilibria. Students had several previous thermodynamics courses. The instructor had over 20 years of experience and has won several teaching awards.

The Concept Warehouse allows students to respond in class using their smart phones or other devices. However, both instructors chose to have the students respond to the reflection prompts outside of class and allowed around 1 week for students to submit their reflections. Both instructors read

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through the student reflections weekly and communicated to the students about them. The instructor in the Second Year Course responded to the reflections in writing and posted the responses on the learning management system for the course. The instructor for the Third Year Course selected representative responses, displayed them to the class, and led an interactive discussion.

For each course, we analyzed three sets of student responses using an emergent coding scheme. We wanted longitudinal data to evaluate if student responses changed during the term. We also wanted to avoid coding weeks that aligned with test dates. During weeks that included tests, a large number of student responses focused on the test without giving specific detail about what students found surprising or muddy about the test. For example, many students responded with only the word "exam" immediately after they were given the test. While this finding is interesting in itself, it precluded those weeks from detailed analysis. Based on these criteria, we coded responses from week 1, week 3, and week 7 for the Second Year Course and week 1, week 4, and week 7 for the Third Year Course. Table 1 shows the number of responses coded for each week for each course.

Table 1. Number of Students Responding Each Week

	No. of Coded Responses	
Week	2nd Year Course	3rd Year Course
1	192	183
3, 4	178	185
7	152	176

To answer research question 1, we counted how many times students chose each prompt (Muddiest Point, Most Surprised, or both). To answer research questions 2 and 3, we first analyzed responses using open coding, a process that allowed us to emergently create categories of meaning.[21] To code the responses, we first reviewed them for reoccurring responses that could be used to generate general coding categories. After the initial set of categories were identified, there were a few responses left without a category. If these responses could be related to one another, a new category was created. When all of the remaining responses were unconnected, both to each other and to existing categories, they were coded with the catch-all category "Other."

We then had independent researchers code a subset of data to ensure interrater reliability. Fifty responses for each prompt (100 total) were independently coded by two researchers. An interrater reliability using the Cohen's Kappa statistic of 0.94 for Muddiest Point and 0.92 for Most Surprised was achieved. These values show acceptable reliability for the coding process. After reliability was confirmed, we applied axial coding to the entire set of participant responses for the 3 weeks that were identified in both courses.

Overall, 17 and 19 coding categories were generated for the Second and Third Year Courses, respectively. Essential themes emerged using a thematic analysis[22] and led to two final category types, including the following: "Structure" and "Content." Codes contained in the Structure category involve elements of how the course was organized and delivered; they do not contain references to specific course content. These codes include "teaching style," "course structure," "studio," "book," and "homework." The Content category consists of codes related to course-specific conceptual knowledge and procedural fluency through codes including "course content," "example," and "specific problem."

Table 2 and Table 3 contain a list of the generated Structure and Category codes, respectively, as well as a code description, and both a Muddiest and Most Surprised example response. For simplicity and ease of comparison between cases, the examples are all taken from the Third Year Course. Finally, as we coded, we noticed some clearly emotive responses. To capture this aspect, we recoded the entire response set separately for a third category type: "affect." Table 4 shows the coding scheme for affective responses. When a response was either clearly "positive" or clearly "negative," it was coded as such; otherwise, it was considered neutral. The codes in Table 4 were assigned to each response in addition to those in Table 2 or Table 3.

This assessment allowed us to categorize the content and affect of the student responses. We then quantified these data by recording the number of codes in each category. Since the resulting data are categorical, we used nonparametric chi-square tests for independence. For cases with two variables, analysis used contingency tables, while, for more than two variables, log linear (Poisson) regression was used.[23,24] A threshold of α = 0.05 was used to determine significance.

In part, we used the methodological approach of grounded theory[25] where we had no preconceived notions of how students would respond or of the response categories themselves. In that spirit, we also used a nonscripted protocol for regular instructor interviews. The interviews generally inquired about the instructors' experience with the activity and their approach to addressing student responses. We also asked about their attitudes toward the hybrid prompt relative to the more common Muddiest Point by itself. We used the interviews for triangulation by analyzing the degree that the instructors' interpretations and actions to the reflection activities were consistent with the final code set. We also sought to better understand how the instructors made use of the reflection activity and how it impacted their attitudes about practice.

RESULTS

The percentage of students who chose each prompt is shown by class and week in Table 5. In every case, more students chose to respond to the Muddiest Point prompt (50−75%) than the Most Surprised prompt (20−42%), and relatively few students chose to use both prompts (2−8%). As the term progressed, the percentage of students that replied to the Muddiest Point prompt relative to the Most Surprised significantly increased for both the Second Year Course (χ^2 = 23.3, df = 6, p = 0.0007) and the Third Year Course (χ^2 = 24.5, df = 6, p = 0.0004).

We next present results to open coding analysis. As explained above, most of the generated coding categories were grouped into either Structure or Content aggregate categories (see Tables 2 and 3, respectively). The coding category "other" was not included in either aggregate category. The code counts were distributed broadly across the various Structure categories in Table 2. In contrast, the majority of code counts for the Content category in Table 3 were identified with the "Course Content" code and were specific to the topic of that given week. For example, in week 4 in the Third Year Course, Course Content coded reflections referred to concepts of "entropy," "hypothetical paths," "partial molar properties," and "Gibbs Energy."

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Table 2. Structure Coding Categories for Reflection Prompts

		Examples (From the 3rd Year Course)	
Category	Description	Most Surprised	Muddiest
Teaching style	Responses involving the instructor, their teaching approach, and/or how they run the class	"What surprised me the most were the simple and clear explanations of equilibrium and other thermodynamic concepts. For example, I felt [instructor] clearly explained the relationship between an extensive variable and intensive (molar or specific) variable with the equation K = k*n…"	"I feel that following Friday's lecture was too confusing. I did not understand the way that instructor writes the equations and he he ended up with fact. I needed to go back to the book and check out the details of that equations and what the symbols are representing for."
Class structure	Responses relating specifically to the organization and framework of the course	"I was surprised at how the class is structured. I like participating in class on Wednesdays via the concept warehouse site through answering interactive questions. I like that this term there will be more of a focus on the explanation for these concept warehouse questions because oftentimes I feel as though I know an answer but I am not positive as to why it is correct."	"My muddiest point this week was the connection between studio and class. We were working with liquid vapor equillibrium in studio and gibbs free energy, while in lecture it has been more of a review of 311. I guess im just having a hard time getting into the swing of things."
Studio	Responses focusing mainly on the studio session of class in which students break into small groups and complete worksheets	"The studio simulation, was tricky to figure out but was a pretty cool simulation once we got the idea of how to run it."	"My muddiest point was during studio. We were only given one worksheet per team. We completed both the studio and the homework part A section, but I'm unsure whether or not I need to fill out another one individually or not…"
Homework	Responses relating to the overall role homework plays in the course as opposed to specific concepts within homework assignments	"That we turn in 2 HWs per week"	"The muddiest point is that we have too much homework. So it is hard to manage our time and give some time for the other homework."
Book	Responses focusing on the role the textbook plays in the course	"There is a gap between the text and the class"	"Why the people that purchased the physical copy of your book get an unfair advantage over the people that purchased the online edition on exams. The people with the physical books can write as much as they'd like in the margins of their books, but the people that had to have "pre-checked" pdf copies did not have that advantage. Open book = Open note."

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Table 3. Content Coding Categories for Reflection Prompts

Category	Description	Examples (From the 3rd Year Course)	
		Most Surprised	Muddiest
Example	Responses involving sample problems or demonstrations done in class	"I've known since physics 211 that volume is not conserved but it was really surprising to see it change so much when mixing two different liquids. 2 mL out of 80 mL is over 2%. I would not have guess it would change in a way that you could measure with the naked eye."	"The cartoon representations of a and b were very hard to follow."
Specific problem	Responses focusing on particular problems students worked through in the course	"What surprised me was when two equal sized compartments of O2 was separated by a partition, and when the partition was removed, there was no change in the entropy of the system."	"How did the equation from studio with the ln(P2/P1) and ln(T2/T1) turn into one with only mole fractions? Also, why are intermolecular interactions more important than configurations when finding change in entropy?"
Course content	Responses relating to specific content covered in class	"What surprised me most about this week was how an increase of pressure meant a decrease in entropy because I have never thought about the relation of pressure to entropy change in my previous courses."	"I am still having troubles understanding how Gibbs energy changes when we have a real gas versus having an ideal gas. Also I do not completely understand partial molar gibbs energy."

Table 4. Affective Coding Categories for Reflection Prompts

Category	Description	Examples (From the 3rd Year Course)	
		Most Surprised	Muddiest
Positive	Responses with clearly positive connotations	"I really liked the format of the group participation Concept Warehouse on Wednesday. It was a much more helpful method of understanding the base information. Much better than any other class I've been to that has used Concept Warehouse. I think I'm finally nailing down the concept of entropy."	"After the class this week I have a better understanding of the relationship between Gibbs free energy and equilibrium, and how to judge the direction of phase transfer based on certain equations."
Negative	Responses with clearly negative connotations	"How terribly structured the studio is. The TA said they cannot help us. What's the point of even having a studio if we get no feedback or at best late feedback a week later. That is not helpful at all."	"I had a lot of trouble in the studios. I know the point is to kind of leave us with minimal guiding in the beginning, but my studio TA was the opposite of helpful. I had the correct answer on my sheet, the TA told me something incorrect so I changed the answer, then he came back and indicated I had the wrong answer and had indeed been correct initially, and it was a huge waste of time."
Neutral	Responses not coded as positive or negative	"The part about lecture that surprised me the most was that at equilibrium the change in moles of a substance at state alpha is equal to negative of the change in moles at state beta."	"I was confused on how volume may relate to Gibb's energy. Also, I was not sure when to use the definition itself or the differential form of Gibb's energy when analyzing situations."

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Table 5. Distribution of Student Responses to Each Reflection Prompt[a]

	Student Responses to Each Reflection Prompt by Course, %					
	Muddiest Point		Most Surprised		Both Prompts	
Week	2nd Year Course	3rd Year Course	2nd Year Course	3rd Year Course	2nd Year Course	3rd Year Course
1	59	50	36	42	5	8
3, 4	74	61	24	32	2	8
7	75	67	20	27	5	6

[a]See Table 1 for the number of responses by week for each course.

Table 6 contains data of the Content and Structure codes from the Second Year Course, and Table 7 contains data from the Third Year Course. Log linear regression analysis shows that there is a significant change in the dependent variable (Structure vs Content) both with week (χ^2 = 14.8, df = 2, p = 0.0006) and with prompt (χ^2 = 15.9, df = 3, p = 0.0012), but there is not a significant difference with course (χ^2 = 0.14, df = 1, p = 0.712). As the term progressed in both courses, significantly more student responses were directed toward the content (concepts and procedures) of the course rather than its structure. In addition, a higher proportion of responses to the Most Surprised prompt (relative to the Muddiest Point) addressed structure. Even though the courses were at different levels and taught by different instructors who communicated the results of the activity differently, there was not a significant difference in these trends between courses.

Table 8 shows the percentage of clearly positive or clearly negative affective responses. Two responses were coded as both positive and negative, and although we included them in the statistical analysis, they are omitted from Table 8. Since the majority of responses were neutral, we report the percentages relative to the total positive and negative codes for each course; however, the statistical analysis includes neutral responses as well. The Most Surprised prompt, which students can use to express successes, elicits significantly more positive responses while the Muddiest Point prompt elicits more negative responses (χ^2 = 22.8, df = 3, p < 0.0001). The number of positive responses also decreases with week (χ^2 = 26.4, df = 2, p < 0.0001). Again there is not a significant difference between the Second Year Course and the Third Year Course (χ^2 = 2.3, df = 1, p = 0.130).

DISCUSSION

Muddiest Point and Most Surprised reflection activities have several purposes. First, they communicate information to the instructor with regard to the attitudes, understanding, and learning approaches of the students. The specific difficulties and concerns that emerge can then be immediately addressed. With these reflection activities, the instructor also gains insight into aligning upcoming content with prior knowledge for better levels of comprehension. Second, these activities foster metacognitive and reflective awareness in students. They must contemplate and gauge their own learning relative to the course objectives, processes, and structures.

Taking Reflection beyond Misconceptions

A focus such as responses identified in our Content category is typical of the uses of Muddiest Point reflections reported in the literature.[1,2,5,8] In this way, students communicate to instructors and to themselves topic-specific concepts and procedures that are difficult for them. We see this type of information provided to instructors in the responses in this study, and the proportion of this type of response tends to increase as the course progresses. However, the use of the reflection activity shown in Figure 1 also provided the instructor feedback on course structure, information not typically identified with Muddiest Points alone. We found that many students used the reflection questions to submit suggestions for ways to improve the effectiveness of course management and delivery. In this way, the reflection activity functions in the manner of a regular (weekly) formative student evaluation of teaching. An instructor who reviews responses can adjust the structure of the course or their teaching practice without the need of a formal midterm evaluation and without waiting until the end-of-course evaluation. The decrease in the proportion of responses categorized with the Structure code may indicate that changes were being made. We next provide two specific examples.

The following response was available to the Instructor after week 1 in the Third Year Course:

Muddiest Point: "In class, the notes [Instructor X] writes on the whiteboard are not large enough to be seen in the back of the room. I think a better way to present notes in class would be to write on paper and show it on the DOC CAM."

This Muddiest Point response was one of several that the instructor received about the difficulty of reading what he wrote on the whiteboard during class. Historically, this instructor had used a white board or chalk board during class. However, increasing enrollments had shifted the course to larger and larger classrooms. What worked well with a smaller class (writing on the board) had apparently become troublesome for those students who were further away. These responses provided helpful and immediate feedback that led the instructor to adjust how he presented material. While this adjustment was simple to make, the reflection activity provided communication that may not have occurred otherwise.

In the same week, the instructor read the following response:

Most Surprised: "I really liked the format of the group participation Concept Warehouse on Wednesday. It was a much more helpful method of understanding the base information. Much better than any other class I've been to

Table 6. Distribution of Aggregate Code by Prompt for Second Year Course[a]

	Aggregate Code by Prompt for 2nd Year Course, %					
	Content		Structure		Both Aggregate Codes	
Week	Muddiest Point	Most Surprised	Muddiest Point	Most Surprised	Muddiest Point	Most Surprised
1	43	9	15	26	4	3
3	49	9	24	8	9	2
7	74	17	2	2	5	1

[a]See Table 1 for the number of responses by week.

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Table 7. Distribution of Aggregate Code by Prompt for Third Year Course[a]

	Aggregate Code by Prompt for 3rd Year Course, %					
	Content		Structure		Both Aggregate Codes	
Week	Muddiest Point	Most Surprised	Muddiest Point	Most Surprised	Muddiest Point	Most Surprised
1	37	25	14	14	5	5
4	59	21	5	7	5	3
7	67	13	6	11	2	1

[a]See Table 1 for the number of responses by week.

Table 8. Percentage of Affective Coding

	Positive and Negative Affective Codes, % N = 82 (2nd Year); N = 106 (3rd Year)			
	Positive		Negative	
Prompt	2nd Year Course	3rd Year Course	2nd Year Course	3rd Year Course
Muddiest	7	7	39	31
Most Surprised	38	42	12	10
Both	1	3	2	6

that has used Concept Warehouse. I think I'm finally nailing down the concept of entropy."

The instructor had deliberately framed the Concept Warehouse activities by discussing with the class characteristics of scientific reasoning and collaborative meaning making. The Most Surprised reflection provided information to the instructor that his intentional emphasis on collaborative reasoning during active learning was taken up (at least by this student).

Many responses suggested conceptual difficulty or structural deficiencies. In their interviews, both instructors commented that having a set of positive or even interspersed personal responses (such as when a Third Year Course student submitted: "most surprised by how much you like coffee") uplifted them. Reading about aspects of class that students enjoyed or the successes students celebrated was encouraging to the instructors.

Research Questions

We next address the research questions for this study:

For research question 1, we found that more students selected the Muddiest Point prompt, but still a significant proportion choose the Most Surprised prompt, and a small amount selected both. As the term progresses, the proportion of Muddiest Point responses increases and Most Surprised decreases.

For research question 2, we found that both prompts elicited responses about both the content and the structure of the course; however, the proportion of responses was different. Students who chose the Muddiest Point prompt were more likely to contain content-specific responses while the Most Surprised responses were split evenly between content and course structure. As the term progresses students focus more on course content and problematic concepts instead of commenting on the overall class organization or the teaching practices of the instructor. This shift can be explained by adjustments of class participants; as students adjust to the way the class is taught and instructors adjust course delivery based on student feedback, the students become more likely to reflect on specific course content as opposed to course structure. This explanation is consistent with the results from research question 1 which show that the Muddiest Point prompt becomes more prominent throughout the term. Alternatively, it is plausible that a greater focus on content results since course content becomes more sophisticated as the term progresses.

For research question 3, we found that although the majority of the responses from the two courses were coded as neutral, there was a correlation between the two reflection prompts and the responses that were coded as positive or negative. The Most Surprised prompt yielded more positive responses whereas the Muddiest prompt was more frequently negative. The Most Surprised prompt allows students an opportunity to reflect on their successes throughout the course; these positive responses are also uplifting for instructors as they review student responses.

LIMITATIONS AND FUTURE RESEARCH

This study has several limitations. First, the reflection activity was only implemented at one university and with one group of students. Although two courses were involved, the data from the Third Year Course was gathered the year following the Second Year Course; therefore, it was collected from the same cohort and there was significant overlap in the group of students sampled. To determine the generalizability of the results presented in this article, similar implementations of this hybrid reflection activity and analyses of student responses should be done at other institutions, in other disciplines, and with other groups of students. Second, in order to encourage student engagement in the reflection activities, both instructors offered participation points to students who submitted responses. While this practice encouraged student responses, students who were only concerned with their grades may have submitted lower quality responses that may not be reflective. In that sense, this activity may be better viewed as an opportunity for reflection. Third, while the students had opportunity to select both prompts by checking both radio buttons, that option may not be obvious from the user interface (Figure 1). More students may have chosen both with a different user design. The results should be interpreted with this limitation in mind. Finally, there is inevitable inference in determining positive or negative connotations from student writing. To address this concern, a conservative coding protocol was developed where the researchers only coded responses as positive or negative when it was abundantly clear the student projected those emotions; however, this coding process led to most of the responses being coded as neutral.

The instructors also experienced some limitations while implementing the reflection activity. The instructor of the Second Year Course commented that responses that would be coded as Structure could be contradictory, and he was unsure how to respond. He also expressed disappointment by the lack of depth of some student responses. However, the Third Year Course instructor did not report any concerns about the

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ambiguity of structure or the quality of student responses. While both instructors read the reflections and responded, they had very different practices in communicating with the class. The Second Year Course instructor posted the responses on a learning management system while the Third Year Course led an interactive discussion in class. We also saw a significant decrease in the student participation in the reflection activity in the Second Year Course but not in the Third Year Course (Table 1). We speculate all these factors may be related and suggest research connecting classroom practice around communication in this type of reflection activity is needed.

CONCLUSION

In this study, we analyzed student responses to a hybrid reflection activity where students could select among a Muddiest Point, a Most Surprised, or both. It is well established that Muddiest Point reflections activities provide instructors with feedback on the conceptual and procedural challenges students are facing. While our results confirm these findings, we also noticed students were able to report structural barriers in course organization and teaching practice. There is increasing interest in formal formative assessments of teaching during a class (as opposed to at the end). The information in our hybrid reflection allows instructors a sense of what does or does not work for students early in a course, and regularly throughout the course, as opposed to relying on typical end of the term teaching assessments. Our study suggests that this type of information can be obtained by appropriate reflection activities and does not need to be an additional midterm evaluation survey. Receiving weekly feedback allows instructors to adjust class processes as they are occurring instead of waiting until the next iteration of the course.

We also found that the hybrid activity more readily allowed positive experiences to be expressed and shared mostly through the use of the Most Surprised prompt. We believe opportunities for such positive communication make for a healthier learning ecosystem for both students and the instructor.

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Notes

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