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STUDENTS' PERCEPTIONS OF ACADEMIC DISHONESTY IN THE CHEMISTRY CLASSROOM LABORATORY

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ABSTRACT

Although the literature on both academic dishonesty and scientific misconduct is extensive, research on academic dishonesty has focused on quizzes, exams, and papers, with the virtual exclusion of the classroom laboratory. This study examined the distinctions undergraduate chemistry majors made between academic dishonesty in the classroom laboratory and scientific misconduct in the research laboratory. Across the spectrum of undergraduate chemistry courses, from the introductory course for first-semester chemistry majors to the capstone course in instrumental analysis, we noted that students believe the classroom lab is fundamentally different from a research or industrial lab. This difference is so significant that it carries over into students' perceptions of dishonesty in these two environments.

INTRODUCTION

The literature on academic dishonesty provides conflicting answers to one of the most fundamental questions in the field: How often does it occur? Different studies have reported values from as low as 9% to as high as 95% of the student population admitting that they have cheated at least once during their academic careers (Maramark & Barth Maline, 1993). Much of this discrepancy stems from the wide variety in definitions of cheating. The definition becomes particularly blurred once collaborative assignments are introduced into the curriculum.

A comprehensive study of factors such as age, gender, academic achievement, and discipline on the frequency of 21 different self-reported cheating behaviors noted that cheating was reported by more younger students than older students, by more men than women, by more lower-achieving students than high-achieving students, and by more science and technology students than those in other disciplines (Newstead, Franklyn-Stokes, & Armstead, 1996). These conclusions, however, are based on self-reports of behaviors, which is a possible source of error.

The classroom environment also makes a difference in the amount of cheating that occurs (Pulvers & Diekhoff, 1999). Students who admitted to cheating in one of the participating classes in Pulvers' study also felt the class was less personalized, less satisfying, and less task-oriented than students who did not admit to cheating. The environment also correlated with an increase in neutral perceptions of dishonest behaviors.

Sims (1995) noted that certain specific forms of academic dishonesty — such as lying to an instructor, looking at another student's paper during an exam, and using sources in a paper not included in the bibliography — were considered to be more severe forms of dishonesty among faculty than among students. The gap in perceived dishonesty diminished, however, as the students became older.

The reasons why students cheat is varied, including the personality of the students, desire or pressure for grades, immaturity, poor college policy, and the lack of role models (Dowd, 1992). McMillan (1989) argued that students perceive a need to cheat to get ahead in the world:

> Values [are] defined by students as relativistic and in terms of personality and personal modes of conduct, stressing careerism, self-centeredness and personal accomplishment ... The students explained their careerism and self-centeredness as being necessary in today's society and culture (p.9).

Tom and Borin (1988) cited The Carnegie Council Report (1979), which states that "students feel that 'some forms of cheating are necessary to get the grades they want'" (p. 153).

Greene and Saxe (1992) argued that students cheat because it is an easy way to get what they want for a minimal amount of effort. They noted, however, that students who are certain that they will fail, or those who are certain they will do well, usually do not cheat because they feel it will not benefit them in any way. David and Kovach (1979) concluded that some students feel the university owes them their grades because they pay so much in tuition and fees.

Research on academic dishonesty has uncovered a variety of excuses students use to justify their behavior. The most common excuse is based on students' tendency to compare themselves with their classmates — "everybody else is doing it," other students cheat more often they do, and/or their behavior "is less bad than that of other people they know" (Greene and Saxe, 1992). Greene and Saxe also noted that one of the most common forms of cheating — working on an individual assignment with someone else — was ranked as one of the least dishonest.

McCabe (1997) and McCabe and Trevino (1997) argued that one of the most influential factors for students is approval or disapproval by peers; students involved in a community such as a sorority or fraternity were more likely to cheat because it was approved by other members of their group. However, this influence was found to work in both directions. McCabe and coworkers later reported that honor code and modified honor code systems establish atmospheres on campus where peer-reporting is more common and, consequently, dishonest behavior is not as frequent (McCabe, Trevino, & Butterfield, 2001, 2002).

Wilhoit (1994) argued that plagiarism is different from cheating. It occurs most often because students do not know what is acceptable and what is not. Wilhoit argued that many students arrive at college not having been taught how to document sources properly.

Research on cheating and plagiarism tends to focus on exams, papers, and homework assignments. Even surveys of cheating in science courses (Lord and Chido, 1995) have ignored what happens in the lab. In one of the few studies that address issues specific to science classrooms, McCabe (1997) found that the occurrence of cheating is not equal across the disciplines of science and engineering. He noted that engineering students cheated more than social science students, who cheated more than natural science students. He also noted that fabrication of data was the most common form of cheating among science and engineering students. Several factors are listed that students use to justify their actions, including poor facilities and materials, lack of time, poor TA's, and irrelevance of the labs.

Rigano and Ritchie (1995) addressed students' fraudulent practices in a classroom laboratory as part of a study of the value of written reports. Using laboratory observations and interviews of nine high-school students in chemistry, physics, and a special chemical engineering program they found four types of fudging behavior: (a) making results fit the book, (b) checking with classmates, (c) excluding anomalous data, and (d) making up/stealing results. They also explored factors students believe contribute to this behavior, which included not having enough time, the students already knew the answer, and the requirement of a written report.

Although the literature on academic dishonesty is extensive, there is a distinct lack of information pertaining to the academic requirements of the science laboratory, in general, and the chemistry laboratory, in particular. A study was therefore carried out that included the following guiding research questions:

- What are chemistry students' perceptions of academic dishonesty in a laboratory based class?
- What distinction, if any, do these students make between academic dishonesty in the classroom laboratory and scientific misconduct that may occur in a research laboratory?

THEORETICAL/METHODOLOGICAL FRAMEWORK

The theoretical framework chosen to shape this work was symbolic interactionism (Blumer, 1969; Schwandt, 1997). Traditionally grounded in elements of social psychology, symbolic interactionism asks "What common set of symbols and understandings have emerged to give meanings to people's interactions?" (Patton, 1990). Symbolic interactionism assumes that meaning is only established through social communication and is "objective or behavioral" (Gallant & Kleinman, 1983). A particular meaning is not determined by an individual's experiences, but by the social interactions individuals have with their peers. It is these constantly evolving meanings that determine people's actions.

This work focused on the ethics or ethical philosophies – "objects" in symbolic interactionist terms – that students develop through their interactions with other students, research advisors, professors, or TA's in the laboratory setting because the way students act in this environment is determined by the meanings that these ethical philosophies have for them. These interactions within the classroom laboratory environment play an important part in the evolution of meanings for the individuals involved in the interaction. The classroom laboratory is a social environment in which contextualized interactions take place and therefore possesses social meaning for those individuals participating in that environment.
In this study, the first research question aimed at understanding the meaning that academic dishonesty had for students in a chemistry laboratory classroom. The second question addressed the context of these meanings; what changes in meaning occur when the student moves from the lab environment associated with an academic course into a research laboratory?

From the perspective of methodology, the main goal of an interactionist is to use observable interactions to identify implied symbolic behavior (Denzin, 1969). This goal indicates that certain research practices need to be followed. First, both behavioral analyses and analyses of personally held meanings and definitions must be examined. This means that data must consist of both observations of actions in the laboratory environment and in-depth interviews to uncover individual meanings. One without the other would only allow the researcher to gain insight into either the observable or the implied, not both. Second, the researcher must view things through the perspective of those under study. Participant observation becomes a key method here; it allows the researcher to contextualize the data being collected and participate in the interactions of the subjects.

METHODOLOGY

Laboratory Observations

Observations were made during the Fall, 2000 semester in four courses for chemistry majors:

- CHM 125 is the first half of a general chemistry sequence for chemistry majors. Observations were made on two sections that enrolled a total of 37 students. CHM 125 students worked in lab in pairs or in groups of three on standard general chemistry experiments.
- CHM 241 is a one-semester sophomore-level course in inorganic chemistry to be taken concurrently with the first-semester of organic chemistry, but roughly half of the 16-student section being observed that semester were juniors (or seniors) because of conflicting advice from undergraduate advisors. Lab experiments typically involved synthesis and characterization, with the exception of a two-week, 20-unknown qualitative analysis experiment for which the students were not given any procedural directions. Students worked in groups but turned in individual lab reports.

- CHM 321 is the first analytical chemistry course for chemistry majors, which is usually taken during the sixth semester, but it is also taken by pharmacy and health profession majors who range from their fifth to their eighth semesters. The 18 students being observed worked in groups of 4-5 people. The groups self-divided according to major, which left students from the health professions separate from most of the chemistry majors. The lab experiments often involved long periods of data collection through a computer interface, so students often sat around while one or two members of their group changed samples between runs.
- CHM 424 is a senior-level instrumental analysis course for chemistry majors pursuing an ACS-certified B.S. degree. A few students were chemical engineering majors, but all students were in their seventh or eighth semester of school. The section observed contained 13 of the 19 students enrolled in the course. Students worked in groups of 2-5 people, carrying out three to four experiments in each of the four units of the course: chromatography, electronics, spectroscopy, and independent projects.

Extensive field notes were taken in each class, which focused on behaviors, actions, events, and interactions in the classroom laboratory setting. These notes were transcribed, and upon reflection, expanded into an electronic form within 24 hours of the observation. The researcher did not distance herself from the students; she walked around the lab, answering questions within the comfort limits of the TA assigned to the section, and made her presence known. Many of the students in the upper-level courses knew her from previous courses in which she had been a teaching assistant and so the students and the observer were often familiar with each other. Students in all classes were informed of the purpose of the study which may have altered their behavior. However, it is hoped that the duration of the observations and the researcher's familiarity with many students, minimized this effect.

Interviews

Volunteers for individual and group interviews were solicited from the lab sections in which observations were made. Every student who volunteered to participate in the interviews was involved in either an individual or group interview depending on what fit into students' schedules. Questions asked during the interviews were based on the observation notes taken throughout the semester. As a result, the interviews were not conducted until the second half of the semester.

A total of eight individual interviews were done on a sample population that included two students from CHM 125, two from CHM 241, two from CHM 321, one from CHM 424, and one who was concurrently enrolled in the CHM 241 and CHM 424 sections being observed. The student enrolled in both CHM 241 and CHM 424 also participated in a CHM 241 group interview and offered unique insight into a comparison of the two classes.

Focus group interviews were conducted because it has been argued that people are more likely to disclose information about sensitive subjects in a group setting (Farquhar & Das, 1999). Group interviews were conducted with two groups of volunteers from each class, for a total of eight groups. With the exception of the student enrolled in both CHM 241 and CHM 424, participants in the group interviews did not take part in individual interviews. Group size ranged from 3-5 students and participants met at a coffeehouse off-campus in an enclosed conference room. Groups were organized such that at least two students in each group regularly interacted in lab.

The structure of both the group and individual interviews was similar and started with the question “What did you think of the CHM [insert course number here] lab?” Where the interview went from there was determined by the students. However, in guiding the interview the researcher made a point to address issues such as the social aspect of lab, amount of time in the lab, comparisons to research or industrial labs, and how academic dishonesty could play a role in their lab settings. Each topic was introduced or tied to something specific in the students’ laboratory. The researcher tried to stay out of group conversations as much as possible, only intervening to start, redirect, or probe the conversation further. All interviews were fully transcribed for analysis by the researcher following a self-made protocol which documented not only the verbal conversation, but also laughter, large breaks in conversation (>30 seconds), and outlandish behaviors such as a participant leaning in toward the microphone to emphasize a point. Ultimately, only verbal conversations were utilized in the data analysis and coding of the text. Since the transcription process lasted long after the completion of the semester, students were not available to review the final transcripts. However, each interview was reviewed by the researcher three times: (a) before any transcription took place, (b) for transcription purposes, and (c) after completion of the transcript to correct any errors.

Data Analysis

The Atlas.ti (Muhr, 1997) program for qualitative data managing was used to aid in the inductive analysis of the transcribed data. Each data set — observations, individual interviews, and group interviews — was analyzed separately. The classroom observations were analyzed first because they involved the least amount of direct feedback from the students. Upon reading the notes, particular themes of behaviors and interactions arose and passages of text were assigned codes corresponding to the category the text supported. After preliminary coding was finished, the code list was modified slightly and used for preliminary analysis of the group interviews, and then, finally, the individual interviews. Modifications included the deletion or addition of codes when applicable to the specific text under analysis. For example, the code “reference”, which referred to occasions when students asked the observer questions about a particular experiment in the laboratory setting, was eliminated from the coding scheme for the interviews since students were not performing experiments during the interviews. The code “class lab”, on the other hand, emerged from the interviews when students spoke explicitly about the classroom laboratory. This code did not appear in the observation notes because the environment was a classroom laboratory; there was no

need to state it explicitly. For the most part, however, the coding scheme remained intact through analysis of all data.

After the data were coded, each data set — class notes, individual interviews, and group interviews — was re-examined separately to refine the codes. The refining process involved breaking an assigned code down into sub-codes. These sub-codes were then used to construct a network of connections centered around the original, central code (see Figure 1). Each sub-code is relationally associated with the central code. For example, the sub-code “supervision” is a part of the “class lab” and is indicated as such on the network using a symbol to represent the relation “is a part of.” Due to the consistent coding scheme, the same central codes appeared in each data set, so the networks were examined for similar sub-codes and code/sub-code relations between data sets. Codes and relations existing in multiple data sets were used to formulate assertions.

Bias

The sensitive nature of this topic makes it difficult to attend to the issue of bias. First and foremost is the possibility that students would alter their behavior while being observed. In an attempt to minimize this effect, observations were made for every laboratory meeting in each class for an entire semester. This allowed ample time for the students to become comfortable with the fact that there was an extra person present in the lab. Because the researcher played an active role in the laboratory, students opened up their questions, conversations, and actions to her. Admittedly this constitutes changed behavior, but it is also an indication that the students trusted the researcher. Once the trust had been established, the researcher was able to observe behaviors that were purposefully hidden from professors and teaching assistants. Upper-level students who knew the researcher from previous classes, were already comfortable with her presence in the lab and were able to ease other students’ concerns. Also, at the time of the study, the researcher was a graduate student. This role is naturally less intimidating than that of a professor doing a similar investigation. The researcher was not involved outside of the study in any of the participating courses and did not discuss results with any of the participating professors or TA’s. These factors were explained to all students in the hope that their behaviors would closely reflect their true sentiments.

Interview participants were solicited on a volunteer basis under the assumption that they would be the least intimidated by the subject matter and consequently, the most forthcoming with their opinions. Additionally, a total of four interviews – two individual and two group – were performed from each class involving a total of 38 students. The goal of this project was to determine the general perceptions students maintain and, consequently, consistency in any one individual’s answers was not analyzed. However, consistency across interviews was indicated through the coding process of such a large quantity of data.

RESULTS

Two primary assertions emerged from this work:

- Students believe that the classroom lab is fundamentally different from a research or industrial lab.
- This difference is so significant that it carries over into students' perceptions of dishonesty in these two environments.

The following sections use textual data to illustrate these assertions. Each text segment is documented with the course number (125, 241, 321, or 424) and data source (individual interview, group interview, or observational field notes).

The Class Lab is Different from a "Real" Lab

Chemistry majors at many institutions do undergraduate research, sometimes as early as their freshman year. At some institutions, they have the opportunity to get involved in intern or co-op programs that expose them to research in industrial laboratories. In this study, students' perceptions of differences between academic and industrial research was not explored. Therefore, the terms "real lab" or "real world" experiences refer to both academic and industrial research experiences, and these terms are used interchangeably throughout this work.

Since a majority of the students who volunteered for interviews had some experience in a real lab, many drew comparisons between their classroom and real world experiences. Others who did not yet have this experience, commented on differences they believed existed between the "real world" and classroom environments based on their perceptions of the real world. Regardless of the students' levels of experience, it was obvious to both groups of students that the two environments are not the same.

The first major distinction students made between the classroom lab and the real world lab involved restrictions they encountered in the classroom that did not exist in the real world. These include time constraints, a complete-the-task attitude, and structural freedom. These categories emerged independently from both group and individual interviews and are supported by observation notes.

Time constraints. The issue of time and time limitations became a ubiquitous entity as the project progressed. By the end of the semester, 164 entries had been recorded in the observation notes related to issues of time and 95 text passages related to time were coded from the interviews. In fact one of the first distinctions students made between the classroom lab and the real world is the fact that a real world experiment need not necessarily be completed in three (or four) hours. Elliot[1], for example, said:

> Well, research laboratory and classroom laboratory? Well, one thing is it's a lot more um, laid back in research lab. You take your time, you don't have a three-hour limit. (241, Individual)

Jerome, when talking about CHM 321, states:

> I was thinking that you know, we're in there from like, 1:30 to 5:30 on Thursday afternoons ... And if there was some way where you could schedule your lab on your own time or something like that, ... And like, if they have like an open lab where you could go I would probably care more about it or be more interested in it and be more careful like, especially in an analytical class. (321, Group)

Time is a precious commodity to these students and the fact that they are required to do their lab at a certain time, within a certain time, adds an element of pressure they perceive does not exist in the real world. While the students in this study did not necessarily run out of time – quite the contrary in most cases – they still felt pressure to get the experiment done so they could move on to other tasks on their agendas. Pressure that they perceived did not exist in the "real world."

Complete-the-task-attitude. Students made it clear that when they do classroom lab experiments, they are there only to perform the task placed in front of them. This code was originally assigned the name "do what you have to do," which describes how these chemistry majors felt about classroom lab experiments. For example:

> Theodore: Whereas in some of these labs like, you do what you're supposed to do. And then if something doesn't work out or ... the computer doesn't work so we can't do our lab, so then we need to use somebody else's data or the professor's data. (321, Group)

Theodore was very goal oriented in the classroom lab. He set out to do what was asked of him and if that did not yield the required results he resorted to other sources such as the professor or other students to complete the task. Similarly, Lynn states:

> I approach ... classroom labs with more of the attitude of, ok, I'm supposed to learn something from this, let's get it done, ok. (321, Group)

The task Lynn set out to complete was to figure out the pedagogical goal of the lab as quickly as possible. She has turned the classroom lab into a game of guess-what-the-professor-wants. Samantha's discussion of the classroom lab clearly showed how little they care for what they are doing, so long as it gets done:

> Just do it. [laughter] Just do it, it doesn't matter what happens. (424, Group)

These students did not care about learning from the lab as much as completing the task set before them. Sissy sums it up nicely by saying:

> But if you're not really going to go into like, instrumentation you know, this is just another lab. It's just another four-hour analytical class you have to go to and get your data. (424, Group)

Structural freedom. The students also distinguished the classroom lab from the real world on the basis of a series of logistical issues that have been grouped under the idea of structural freedom. The classroom lab was viewed as "structured," whereas there

was more “freedom” in the real lab. This issue goes beyond the time constraints and logistics of scheduling discussed previously. In addition to being confined to one lab space for the duration of the class, many students found the specific procedural guidelines to be a constrictive element of the classroom laboratory:

> Zenith: I mean, yeah kind of just because like, their guidelines. Like there's so many, like you're doing this and you're not really doing anything else. Like it's not like you're going to be like, oh can I get some of this chemical, I want to try this reaction. Let's see if this works you know. (321, Group)

Zenith would have preferred being able to pursue some of his own questions, but instead felt confined to following the procedure written out for him, which quenched any interest he might have had in the chemistry behind the experiment.

Many of the labs were verification labs with a limited scope not only in what the students could do procedurally but also in what was considered to be the “correct” answer (Bodner, Hunter, & Lamba, 1998). This lack of procedural freedom is one source of students’ apathetic feelings toward the classroom lab. Sissy summarized the students’ outlook as follows:

> I don't know it's, to me like the whole classroom lab being a little bit more structured makes a difference. Um, in the fact that you know, you go in and you have this lab and you have to do all these certain steps. (424, Group)

The real lab environment on the other hand, was viewed as much more independent and less restrictive. When Elliot talked about his research lab he noted that he is not told specifically what procedure to follow, just what end product he and his co-worker need to synthesize:

> [The post-doc] just tells us which reactions he wants us to run and we go do it. And then ... if he doesn't have time to tell us let's say, well we need to take this into this so we'll research it ourselves ... after awhile in your own research, lab becomes more independent. You don't need them to tell you. (241, Individual)

Not only is Elliot given free reign on what procedure to use, he is left to his own devices to carry out the procedure, unlike the classroom laboratory where the experimental procedure is explained in explicit detail.

The classroom and real labs were also perceived as significantly different in terms of supervision. Regardless of whether the experiments were “cookbook” in nature or “inquiry”/“discovery” based, the classroom lab was viewed as an environment in which the students were under constant supervision. In the research lab, students were allowed to come and go as they please. When Betty compared research and classroom labs she defined freedom as having more time to work on things:

> Ok, um there's like a little more freedom I guess [in research], you know. ... it's not so structured I guess. ... Because, you just, you come in, you do your work for the day, you know, you set up your reaction whatever, and it's, you're not really limited also with time. Like, ... I mean if this [class lab project] was a project that I was doing in the research lab then, yeah I could have spent that extra time to make the new samples again and done it. So there's no restriction on your time to finish. Well, there's always a restriction to finish [inaudible] eventually, but you have a lot more time to spend on your projects maybe and, and understanding them I guess. (424, Individual)

The dichotomy between the classroom lab and a "real" lab was captured in the code "no similarities." When asked how a class lab and a real lab compare, students responded that with the exception of specific procedures and the fact that they both use chemicals, the two are not at all similar. Consider the following quote, for example:

> Interviewer: So can you draw any connections between something that might happen in a classroom lab with something that might happen in a research lab?
> Elliot: Not really. I mean, I actually was thinking of two different experiences. (241, Individual)

For Elliot, what happens in a classroom laboratory is different from anything that might happen in research. He does not even classify them as the same experience. In one of the CHM 241 groups, the question asking students to compare the classroom and real lab had not been finished before the group blurted out that there were no similarities between the class lab and their real world experiences:

> Interviewer: OK, so each of you have different [real world] lab experiences but how does that compare to
> Tammy: What we do now?
> Interviewer: 241 lab?
> Tammy: No, not similar.
> Sean: No not really.
> Tammy: Nothing, like, the real world is nothing like [241] chemistry lab. (241, Group)

The perception of "no similarities" carried so far that when real world evaluation criteria for publications were used on classroom lab reports it was deemed "unfair".

Dishonest Behavior in the Classroom vs Real World Lab

Because of the drastic distinction students made between the classroom lab and real world lab, it is not surprising that the students differentiated between dishonest behaviors in the two environments. To illustrate the magnitude of the difference, let us consider students' attitudes and beliefs about dishonest behavior in each environment that shape their opinions of what they consider justifiable behavior.

Because students were aware of the purpose of this study, issues of academic dishonesty came up quite often. Their ideas fell into three categories: (a) pre- and post-lab writeups, (b) in-lab activities, and (c) reasons not to be dishonest.

Two codes emerged from the data associated with written work in the classroom lab: “copying” and “old labs as reference.” The students knew that copying an assignment is wrong and is considered dishonest, but other interactions between students are not. Jessica, for example, talks about getting the answers to the CHM 241 qualitative analysis lab from other students in the class:

> I mean, that what, during the, the unknown labs, if we had just gone and said, hey what's this, hey what's this, hey what's this, that's not right. But, if you don't understand how else you can test you can ask how, how you would go about to test for it. (241, Group)

She differentiates between obtaining the answer from another student, which is dishonest, and asking for a hint on how to find the answer, which is not. Theodore talked about a “team environment” that is considered acceptable behavior:

> ... like in this lab you're not like, necessarily copying off people, you're working together. So it's not like, you do all the work and then somebody else just, ok, blindly like writes down what you get ... You're working on it and they're working on it and I mean, its kind of like their work is your work, more like a team environment actually than just like one person doing it ... (321, Group)

This team effort is not considered dishonest and is quite common. In fact, the observations showed that collaboration and data sharing among students was a large part of the chemistry classroom laboratory. So much so that at times it appeared that the whole class was one large group working on the experiment together.

The line between copying and obtaining hints/collaboration was commonly drawn by students, but does not appear to pertain to the pre-lab assignment. This first became clear from the observation notes:

> Mel and Lori are looking off of each other's pre-lab/data while trying to finish up. I don't know exactly what they are copying but Lori turned in her pre-lab with her data, instead of at the beginning of lab. (125, Observation)

In this case it appeared that Lori had not finished her pre-lab in time to turn it in at the beginning of lab when it was due. Instead she waited until the lab was finished and copied from the carbon copy left in her lab partner’s notebook. CHM 321 students confirmed that pre-lab assignments were an exception to the unwritten rule against copying:

> Jerome: I didn't like pre-lab this semester. I asked Lynn for her notebook and ...
> Amy: And I got one from Lynn too, because that one lab that we didn't do in the

> lab, I did not feel it was necessary to write a pre-lab for it because I was not in the lab doing anything. And the pre-lab consists of purpose, and procedure but it was only like a text citation. So I grabbed that off Lynn and I think a lot of people do that. (321, Group)

On more than one occasion Amy and Jerome copied the pre-lab from Lynn because they did not want to do it or felt it was not justifiable to have one. No one mentioned that this might be considered dishonest, and Amy even claimed that it was commonplace. The pre-lab might be an exception to the rule that copying is dishonest because no data are collected with the pre-lab assignment. Because of this, the pre-lab is more like a traditional classroom assignment than part of an "experiment," per se.

Opinions were mixed on the issue of copying old labs or using them as a guide for the current lab write-up. It was interesting to note that this difference of opinion did not revolve around the question of whether this practice was dishonest, but whether old reports were useful. Half of the students found them useful in determining how to approach the write-up or to clarify specific calculations and questions asked of them; the other half did not feel that they needed to use the old reports. Javier, for example, had already done the experiments in CHM 125 when he took a different course the previous year. His graded reports were missing, however, and he reflected on what it would have been like if he still had them:

> Javier: Oh, I would use it ... I would like, try to compare things, not like, exactly use it ... It would like have like, a different view, you know. ... like a plan of what you are doing.
> Interviewer: So, use it as a guide
> Javier: Yeah, exactly. (125, Individual)

Javier does not want the old reports to copy them, but to have an additional resource to help him understand the current experiment better. This strikes us as similar to students' differentiating between copying answers, which was wrong, and asking for guidance, which was acceptable. Bonnie, who was repeating CHM 241, described how she used her old reports:

> Um, what I usually do is I look at my old lab and I see, ok, this is what I missed. So, then I start writing mine going, ok, I know that this is what, kind of, this is what they're looking for on the lab. (241, Individual)

She used the old report to inform her of what information goes into the report, how to do calculations, and how to answer any questions that were asked pertaining to the lab. But she did not (or would not) use the data in the old report.

It is important to note that the decision not to use old reports was based on the perception that these reports were not a useful resource. It was not based on the perception that this behavior would be dishonest. The students were looking for the

fastest and easiest way to complete the task before them. If the old lab reports were considered useful, they were used. If not, another resource was found.

Three codes arose from this study that pertain to issues of dishonesty involving behaviors that occur in the lab, rather than before or after the lab: data sharing, deducting for a wrong answer, and bad lab/technique. “Data sharing” involved students receiving and using experimental data from a source other than the experiment they performed. It is amazing how many times students talked about this and how frequently it was observed in lab. It was more common in the higher-level classes because these classes relied more heavily on instrumentation and computers with which there were often technical difficulties. As a result, students on several occasions in the 321 and 424 courses obtained a data set from another group in order to write their reports. The students were not concerned with how they got the data, as long as they had a set to analyze for their report. One can hardly blame them when this was also the attitude of some of their professors:

> Sandy asks “why are we doing this [experiment]?” Jerome agrees and says the professor says that the data from this lab usually are not very reliable and so he is giving them the data anyway, so why are they doing this? (321, Observation)

In a discussion with the TA’s in staff meeting that week, the professor stated that he wanted the students to have the experience working with a liquid chromatograph, but he felt that the data obtained by the students were not going to be clean enough to make the chemical concepts behind the experiment clear. He therefore had the students go through the motions of the experiment, but gave them a different set of data to analyze for their reports.

Data sharing was not limited to incidents of technical difficulty, however, and was particularly common during the electronics unit of CHM 424. Students found this unit to be the most challenging both procedurally and conceptually, often running out of time. Some groups were able to get one part of the experiment to work, others were successful on another part. In order to have a complete set of data, the groups would swap results.

> So all in all it took three of the four groups to get the data needed for the experiment even after some parts were eliminated from the procedure. It sounds like each group will organize their data and come to class with several copies to pass out to others who need it. (424, Observation)

Even after the TA’s had eliminated some sections of the procedure, it took 10 of the 13 students — 3 of the 4 groups — to formulate a complete set of data such that lab reports could be written. In one of the CHM 424 group interviews Denny reflects on the idea of data sharing and how that may relate to issues of dishonesty:

> I don't know. ... I mean, 'cause like, sharing data, especially in this lab is just kind of, you know you do it lots of times because somebody else has good data and you know, you don't. So that really doesn't seem dishonest. (424, Group)

Because students need “good” data to write their reports, it does not matter where or how the students get the data in a classroom laboratory, as long as the data recorded support the chemical concept the experiment is trying to illustrate. Although students know that copying from others is wrong, when faced with the end of a lab period and a failed experiment, it is acceptable to copy a set of data. The students perceived that it was not their fault; either there was not enough time to complete the experiment, or the instruments were not working as they should. They felt they had done what they were asked to do and should not be penalized for inaccurate or non-existent results.
The code “deduct for ‘wrong’ answer” arose from students discussing how their behaviors change when part of their grade depends on how close they come to a predetermined value. This code is closely related to the idea of getting “good” data discussed above. While not all classes involved in this study structured the grading of reports in this way, almost all of the students had experience with a course that did. Most students felt that being penalized for not obtaining the right answer leads to dishonest behavior:

> Amy: ... in the beginning we used to have ... to turn in and stuff, and you had to have your data. I know some people who like, just totally would fudge it. Like 'cause he ... took off points if you weren't in like, a respective range and he'd tell you what the range was. So people'd be like, oh well, I'm not in the range, ok well slide this here, do this there. And there you go! You're done. I think people do that with percent yields too, a lot of times. (321, Group)

Even in classes where students did not feel they were being graded on accuracy, they could see how this practice would affect their behavior if circumstances were different. This attitude only accentuates the fact that students regard lab as an exercise in data acquisition, not the learning experience educators wish it to be.

The final code, “bad lab/technique” refers to the glitches that happen from time to time in the classroom laboratory. Students either blamed the experiment, claiming it was a “bad lab,” or blamed themselves for messing up somewhere along the line. This reflects students’ belief that classroom labs should work without fail if done correctly. The interview data gave valuable insight into how students chose to deal with these mishaps.

> Theodore: Well the computer doesn't work so we can't do our lab, so then we need to use somebody else's data or the professor's data. So that's dishonest but that's not your fault. you know. (321, Group)

The students had done the lab the way they were supposed to, so they felt entitled to a “good” data set from which to write the report. Theodore’s solution to not having the required data for the report was to get it from another source. He considers this

behavior to be dishonest, but it is acceptable because he did not feel he should be penalized for having the “wrong” data. This is another example of the perception that the goal of the lab is to get a “good” set of data — regardless of how it is obtained — to write the report. As long as the students have acquired a good set of data, the lab can be considered a success.

Students’ Definitions of Academic Dishonesty

Students’ definitions of academic dishonesty in the classroom might be summarized as follows:

- Verbatim copying of materials is dishonest, with the exception of the pre-lab, which is perceived to be more like a homework assignment than a part of the lab.
- Using old materials and other students as a guide through the experiment is acceptable, and sometimes encouraged by the faculty in charge of the course.
- The sharing of data is fundamentally different from copying; it is a means to the ultimate goal of the classroom laboratory — to obtain “good” data. This issue becomes moot in situations where the experiments proceed smoothly and credit is given regardless of the quality of the data.

Students’ Beliefs About Scientific Misconduct

Discussions of dishonest behavior in research or industrial labs were not as extensive in this study for many reasons. First, the students and the researcher did not share common real-world experiences, so she could not ask specific questions about things that might have happened in that environment. Second, not all of the students had experience in a research or industrial laboratory. Finally, students focused on the term “academic dishonesty” and may not have felt the concept applied in the real world. Because attempts were made during interviews to use ambiguous phrases such as “dishonesty”, “ethical issues”, or “issues of dishonesty,” the term “scientific misconduct” was never brought up by the interviewer and it was never used by students referring to the real-world laboratory.

Even without an explicit distinction between academic dishonesty and scientific misconduct, however, students commented on the sole reason why they believed dishonesty in the real world lab is different from that in a classroom lab: There is more at stake in the real world.

When talking about dishonesty in the real world, students focused on the consequences resulting from such behavior. The overall perception is that the consequences of dishonest behavior are greater in the real world than in the classroom lab. Two specific consequences repeatedly brought up by the students were the ideas of losing a job and the ramifications their work may have on other people or communities. Sissy used the idea of losing a job to make a distinction between dishonest behavior in school and in the real world:

> ... and what are you really going to get by cheating somehow in research or on a job. You know, you're probably going to get fired. So there's really nothing to be gained by, by being dishonest once we've left school. (424, Group)

The academic equivalent to getting fired — being expelled from the University — was mentioned as a consequence of dishonesty by only one of the nearly 100 students involved in this study. Because the students have classified school and the real world as such different entities, consequences of dishonest behavior in these two areas are not seen as analogous.

The second consequence students mentioned was how their work may affect the community. One of the CHM 321 groups discussed at length the procedure of performing several trials of an experiment in both the classroom and real world laboratories.

> Amy: If I ever had to [do] a titration in my research lab I would feel extremely horrible just knowing that like, what I'm doing affects other people. (321, Group)

This line of conversation continued for some time, and later, Elliot specifically mentions skipping a third titration in class and how there are essentially no ramifications for that action:

> I mean ... like you said there's no other consequence to you know, forgoing that third trial [in class lab] other than you know, I mean, it, honestly it won't affect your grade any 'cause you're pretty sure that your other two are close and that they're going, you know. But if there's real consequences then I think yeah ... I think that would be pretty important you know, [to do the third trial]. (321, Group)

The students also acknowledged the consequences that exist with respect to ignorance as well as intentional dishonesty in the real world. Ken comically explains:

> Like, if you get in like, a real world job and you really don't like, know what's going on, I mean you're going to get dumped or kill somebody or blow up somebody. (125, Group)

In general the level of significance placed on research or clinical work is much higher than anything the students perceived in lab. Betty summarizes this idea nicely as follows:

> I guess I just consider the research you do in a lab or your job is a lot more important to be honest or, you know important than your lab work at school. ... So I guess I feel like the impact that being dishonest in something like your research or your job is a lot greater than sharing results like, in the lab ...(424, Individual)

The students placed more significance and responsibility on actions that occur in a real-world laboratory compared to the classroom. If something goes wrong in the real world lab, communities are contaminated, citizens become ill or die, and scientists are held responsible and can ultimately lose their jobs. None of these ramifications are possible in the classroom laboratory.

DISCUSSION

The researchers' definition of academic dishonesty has intentionally been excluded from this discussion because the goal of this study was to examine how students define it through their behaviors and interactions in the classroom laboratory. As mentioned in the introduction, students' perceptions of what is considered acceptable behavior is greatly influenced by their peers (McCabe, 1997; McCabe & Trevino, 1997; McCabe et al., 2001). In line with the theoretical framework that shaped this research — symbolic interactionism — we believe that definitions are socially constructed by a group or community. Students in the observed classes worked in groups collecting data, writing lab reports and, on pre-lab assignments. Social interactions were not restricted to those that occur within a single group but extended to the entire laboratory class. This community of students constructed a consistent definition of behaviors that were considered acceptable in the classroom laboratory: (a) copying pre-lab assignments, (b) use of previous laboratory reports and other students as guides to completing the experiment and write-up, (c) using the data of another group when their experiment fails to produce "good" data. They also constructed a consistent definition of behavior that was not acceptable: copying previous lab reports or the work of other students.

The copying of pre-lab assignments appeared to be commonplace, as evidenced by both the observations and interviews. However, this was not the case with other assignments in the classroom laboratory such as lab reports. We suspect that this dichotomy in student behavior results from the fact that the pre-lab is the only aspect of the laboratory environment that does not involve the analysis, interpretation, or reporting of data. Regardless of how the students obtained the data, or even whether the data was their own, the analysis needed to be their own work (even if they received guidance from a previous report or other students). The only exception to this rule occurred when the accuracy of their analysis contributed to their grade. While McCabe (1997) does not discuss this particular issue as a potential factor contributing to the fabrication of data by science and engineering majors, the reasons he cites – poor facilities, poor materials, and lack of time – inhibit the collection of "good" data, to which participants in this study felt they were entitled. This sense of entitlement was used to socially accept the use of another group's data to write a lab report.

It should be noted that the authors differentiated between data sharing and the pooling of data sets to illustrate experimental error. Data pooling implies that each group has a complete set of data to contribute and is a fairly common practice in many classroom laboratories. Data sharing occurs when lab groups who are not able to obtain their own data for analysis, use data obtained from another group to write their report. We realize that this too, may be common practice in classroom laboratories due to the time and

resource restrictions of the classroom laboratory, but this further segregates the classroom laboratory from the real world.

The second goal of this work was to examine how the social definition of acceptable behavior changed when the context of the laboratory changed. Each student entered this study with their own ideas of how a real world lab operates. Regardless of the accuracy of those ideas, the social definition of acceptable behavior within the classroom laboratory changes within that context because students do not feel there are any similarities between the real world and the classroom laboratory. The most significant difference is in students' perceptions of the consequences of dishonest behavior in each of the above situations. As seen in the literature, poor college policies on academic dishonesty can contribute to cheating (Dowd, 1992); if students do not think they will get caught, they are more likely to cheat. However, as seen here, this definition changes when applied to the context of a real lab where the results of an experiment contribute to political, environmental, and social endeavors.

CONCLUSIONS

The goal of this work was to determine students' perceptions of academic dishonesty in the chemistry classroom laboratory and compare them to perceptions of dishonesty in a real world laboratory. This comparison was driven by the significant distinction students made between the classroom and real-world laboratory environments.

Time constraints and the absence of structural freedom contributed to students adopting an attitude of task completion toward the classroom laboratory. Class labs were approached as tasks which needed to be performed to get the grade required to complete their degrees. This was unlike real world labs, where they perceived a much larger amount of freedom to do as they pleased, when they pleased. With this much of a contrast between the atmospheres of the classroom and real world labs, it was not surprising to find that students did not classify dishonest behavior in the same way for the two situations.

Within the classroom laboratory, students differentiated between "copying" from others and "sharing data." The first was considered dishonest; the second was viewed as an acceptable way to accomplish the task set before them. The students also perceived that problems they encountered with obtaining a "good" data set were not their fault, as long as they followed the relatively explicit procedural instructions. This "no fault" perception enforces an already established atmosphere of task accomplishment. Because they felt they had no freedom within the lab, sharing data was the only way students felt in control of their grades.

The chemistry majors in this study also differentiated between copying pre-lab assignments and copying old lab reports. Pre-lab assignments are often mathematical exercises or a summary of the experimental procedure that students' may not regard as a legitimate portion of the laboratory "experiment." Old lab reports can be used in much

the same way that one would ask a fellow student for help, but they cannot and should not be copied.

Overall, students felt that dishonest behavior in the real world lab had much greater ramifications then anything that may be result from dishonest behavior in a classroom laboratory. This may relate back to the idea of data collection. In the real world, not only is the data collected but it is then used to gain information as part of a larger research project. Unlike data that go into a report graded by the teaching assistant assigned to a course, there are implications to data collected in the real world laboratory. This makes the real world lab more important than the classroom lab, and consequently changes the implications of dishonest behavior.

This study suggests that we cannot assume that the classroom lab simulates the real world laboratory. Students operate under the assumption that the classroom lab is distinctly different from anything they will encounter in the real world and therefore fail to see any similarities that we may impose.

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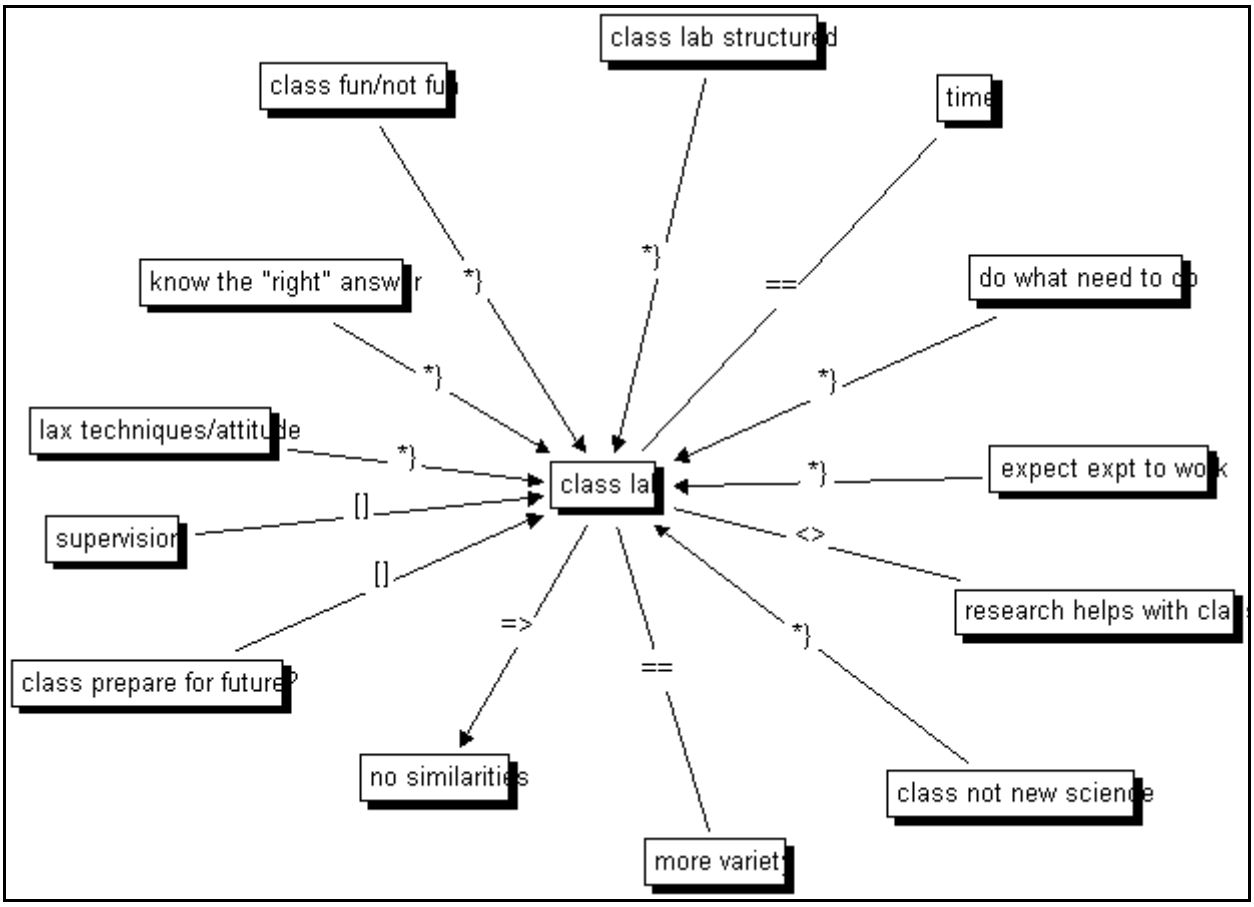
Footnotes

[1]All participants in this study have been given pseudonyms that bare no resemblance to their real names.

Figure Caption

Figure 1. Expanded network of group interview sub-codes from the original, central code “class lab”. Symbols represent the following relations between codes and sub-codes: *} indicates “is a property of”, == indicates “is associated with”, <> indicates “contradicts”, => indicates “is cause of”, and [] indicates “is part of”. Arrows signify the direction of the logical argument. For example; supervision is a part of class lab.


class lab structured
class fun/not fu
time
know the "right" answ r
do what need to d
lax techniques/attitude
expect expt to wo k
class la
supervision
research helps with cla
class prepare for future?
no similarities
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