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Article

Using Hypothetical Scenarios to Address Social Desirability Bias: Investigating Student Perceptions, Evaluations, and Motivations of Cheating and Academic Integrity in the General Chemistry Laboratory

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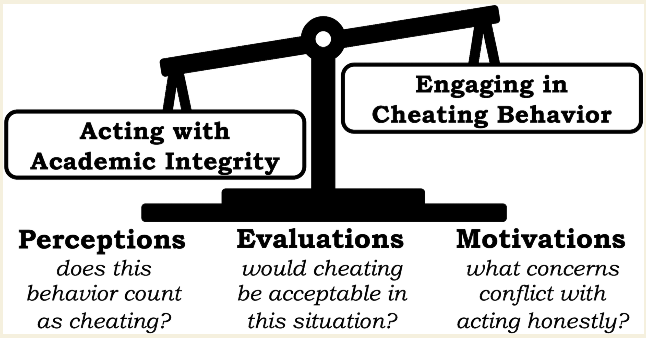
ABSTRACT: Supporting students with upholding the principles of academic integrity is an important aspect of teaching. Academic integrity is especially important in chemistry laboratory classrooms, where students gain hands-on experience related to research and scientific practices. Prior literature on academic integrity largely focuses on catching and preventing cheating, describing various factors commonly associated with cheating behaviors. This body of literature assumes that students neutralize their feelings about cheating to engage in unethical behavior. In contrast, for this study, we began with the assumption that students intend to act ethically; to this end, we sought to investigate students' perceptions, evaluations, and motivations related to cheating and academic integrity. We interviewed 24 students enrolled in general chemistry laboratories and asked questions related to cheating and academic integrity. Additionally, to address concerns about social desirability bias affecting students' responses, we asked students questions involving hypothetical scenarios related to academic integrity that were contextualized within the chemistry laboratory classroom. In our analysis, we found that students held common views about cheating and academic integrity in general but diverged in their responses to the hypothetical scenarios. Our findings suggest the importance of providing clearer, more direct instruction regarding what counts as cheating and how to engage in academically honest behavior within the chemistry laboratory classroom.



KEYWORDS: *chemistry education research, undergraduate education, general chemistry, cheating, academic integrity, ethics*

■ INTRODUCTION

Instructors strive to mentor students into being productive members of their field, which involves not only supporting students' mastery of course content but also teaching students how to operate ethically. Ethics should be central within instruction, because acting ethically is important not only within academia but also in the workforce.[1] Furthermore, instilling a sense of ethics within students as part of their science curriculum is of upmost importance considering the impact of scientific misconduct on public trust in science.[2] An extensive body of research addresses the various academic integrity concerns that exist throughout undergraduate institutions, defining academic integrity as making ethical decisions within the university context.[3,4] Among these concerns are how to maintain integrity during exams and other major assessments.[5,6] Additionally, a considerable amount of literature discusses how instructors' tactics for maintaining integrity must change to address the impact that rapidly advancing technology, such as generative artificial intelligence, may have on academic integrity.[7−11]

Early research in academic integrity utilized quantitative approaches that sought to associate student demographic factors with higher rates of self-reported cheating.[12,13] These studies established the importance of context when considering academic integrity, highlighting various factors which impact the degree of students' self-reported cheating, including assessment types, students' majors, and the presence of honor codes.[14,15] Because of the importance of context, there is a growing body of research focusing on understanding students' perceptions of academic integrity.[16−20] From this work, researchers have established that students and instructors often do not share the same perceptions of what constitutes cheating,[21] highlighting the need for instructors to reflect on their perceptions of cheating and to understand

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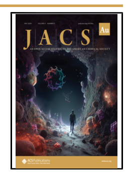

student perceptions. The existing literature provides a foundation for understanding academic integrity throughout the undergraduate experience. However, there remains a need for further research that focuses on academic integrity within specific contexts, especially due to the important role of context in shaping students' perceptions. The goal of this study is to provide a better understanding of the contextual factors that influence students' perceptions of academic integrity in the chemistry laboratory classroom. By understanding student perceptions within this setting, chemistry laboratory instructors will be better equipped to support students with developing their sense of ethics which they will take with them when they enter the workforce.

Early Academic Integrity Research

Early work in the field of academic integrity research focused on associating student demographic factors with rates of self-reported cheating.[12,13] Studies have identified correlations between self-reported cheating and certain factors, such as year in school or hours of employment; however, the reported rates vary significantly from study to study.[13] Research has also indicated that students from universities with honor codes self-report less engagement in cheating.[14] Across these studies, findings generally include lowered rates of self-reported cheating over time; however, these findings do not necessarily indicate that students are cheating less, but that students' perceptions of what constitutes cheating may be changing.[22]

Quantitative approaches focusing on cheating behavior dominated the academic integrity literature for many years, guided by a common framework, neutralization theory. Sykes and Matza[23] established neutralization theory as a component of a broader theory of delinquency that states students who engage in academic misconduct (i.e., behaviors which allow students to gain unfair academic advantage) neutralize their feelings about the unethical actions they take. Research informed by the assumptions of neutralization theory takes the stance that students inherently engage in unethical behaviors in the classroom, feeling little remorse about their conduct.[23] Neutralization theory and the associated quantitative studies have been critiqued for their deficit viewpoint, in that this body of research tends to focus on associating cheating behaviors with individual groups of students rather than seeking to understand the contextual factors which may influence those students to engage in cheating behaviors.[24,25] Another critique of quantitative studies that ask students to self-report academic misconduct is the unknown influence social desirability bias has on student responses.[25] To address these concerns, we highlight the importance of literature on academic integrity that moves beyond neutralization theory in favor of student-centered theories which seek to understand students' perceptions of cheating and the impact of contextual factors.[16−20]

Academic Misconduct in Chemistry Courses

With articles dating back to 1927,[26] instructors have a history of sharing methods for preventing academic misconduct within chemistry instructional contexts. Since these early reports, instructors have been concerned with educating students about the high standards that exist in chemistry research. To support maintaining integrity in the classroom, instructors have shared methods for preventing and catching cheating, such as spacing students apart from one another during exams and detecting similarities on multiple-choice assessments.[27,28] Almost one-hundred years since the earliest reports on academic integrity in chemistry, instructors are still discussing the issue, which has become more complex with the increase in hybrid and remote classrooms due to the COVID-19 pandemic and with advances in technology.[7,8,10,11,29]

Along with these changes to the nature of cheating, the research on academic integrity has simultaneously evolved. Instead of identifying prevention methods which focus on catching and punishing students, the focus has shifted toward understanding students' perceptions of academic integrity.[30] The reasons students provide for engaging in cheating behaviors are largely affective (e.g., pressure for grades, lack of motivation), which may suggest that instructors can create classroom environments in which these pressures are alleviated (i.e., being flexible, using formative assessments, encouraging group work, etc.).[30] Building on the interest in cultivating these environments, several reports identify productive ways of integrating ethics learning outcomes throughout chemistry courses.[31−35] In addition, research encourages instructors to reflect on their perceptions of academic integrity in the chemistry context, which can provide a starting point for supporting students in developing a deeper ethical awareness.[36]

Academic Integrity in the Chemistry Laboratory Classroom

A smaller body of work exists within the chemistry education literature that focuses on students' understandings of academic integrity and ethics within the laboratory components of chemistry courses. In one study, researchers identified that students often feel unsure about their understanding of what constitutes academic or research misconduct and how to apply ethical concepts they know from previous courses to a classroom laboratory setting.[37] In another study, students were found to be more concerned with attaining the "right" answer in their chemistry laboratories rather than learning the techniques being taught.[38] Students' perceptions of academic integrity in these contexts are highly impacted by loyalty to their peers (i.e., the perception that not helping a friend is worse than cheating).[18,38] Students also consistently report an understanding that laboratory work in an academic environment differs from "real-world" laboratory work (i.e., industrial or research laboratories).[39,40] Another study has shown that instructors and teaching assistants play a formative role in classroom laboratory environments and may impact students' development of ethical awareness.[40]

The prior research on academic integrity, both broadly and in chemistry classroom contexts, provides a robust knowledge base for instructors seeking to support ethical behaviors in their courses. However, considering the differences students perceive between academic laboratories and research laboratories, there exists a need for further research dedicated to examining students' perceptions of cheating and academic integrity within the chemistry laboratory classroom. Additionally, because much of the prior literature focuses on students' self-reporting academic misconduct, it is necessary for future work to mitigate and consider the role of social desirability bias on the findings. In this study, we aim to contribute to the literature by asking students to evaluate hypothetical academic integrity scenarios in the context of the chemistry laboratory classroom. We employ the use of hypothetical scenarios to reduce the influence social desirability bias may play in student responses. Through this study, we seek to provide instructors with a deeper understanding of how students evaluate cheating behaviors in chemistry laboratory classroom contexts.

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THEORETICAL FRAMEWORK

This research is guided by Waltzer and Dahl's framework for academic integrity,[16] which contrasts with other frameworks for academic integrity by holding the primary assumption that students' intentions are to act with integrity. The Walter and Dahl framework comprises three components that influence students' decisions to engage in cheating behavior: perceptions, evaluations, and motivations. Perceptions are whether students view specific actions as cheating behaviors; students may perceive any particular action as clearly cheating, *not* clearly cheating, or ambiguous. Evaluations encompass how students view cheating behaviors as acceptable in specific situations. Students may evaluate some behaviors as wrong across multiple situations, or they may justify some cheating behaviors as acceptable given certain contextual factors (such as cheating for a low-stakes homework assignment or cheating after exhausting the resources available for homework support). Motivations capture other concerns students may have which conflict with acting honestly, such as the pressure to achieve high grades, time constraints, or social factors. Together, students' perceptions, evaluations, and motivations regarding specific actions can either push students away from or toward engaging in cheating behaviors.

In addition to Waltzer and Dahl's framework guiding this study,[16] the methods and interpretation of the results were also guided by the literature on social desirability bias. Social desirability bias represents a reasonable concern when conducting research on students' perceptions of cheating and academic integrity, because participants tend to over-report socially acceptable behavior while under-reporting socially unacceptable behavior for situations that have accepted norms.[41,42] Research suggests that methodology may influence responses when asking students about cheating, such as participants responding differently to interviews, written surveys, or online surveys.[22] For interview studies, common approaches for minimizing social desirability bias include developing rapport with participants and asking probing questions.[43] Additionally, whether questions are asked directly versus indirectly can also influence responses (e.g., Direct questioning – *why would you cheat on an exam?* Indirect questioning – *why might a student cheat on an exam?*).[44,45] In the context of research on academic integrity literature, prior research has attempted to mitigate social desirability bias by surveying alumni and purposefully sampling students with instances of plagiarism.[22] For this study, we attempted to mitigate social desirability bias by using the aforementioned strategies for interview studies (i.e., building rapport with participants and asking probing questions). Additionally, we indirectly questioned students about their perceptions of cheating and academic integrity by asking general, open-ended questions alongside using hypothetical scenarios involving cases of ambiguous academic conduct. Furthermore, we interpreted our findings by considering the role social desirability bias may have played in shaping students' responses.

RESEARCH QUESTIONS

This study seeks to understand students' conceptions of cheating and academic integrity in the chemistry laboratory classroom. Additionally, we seek to understand the perceptions, evaluations, and motivations that may guide students' decisions surrounding academically dishonest behaviors within the classroom laboratory context. To address these goals, this study is guided by the following research questions:

1. What are undergraduate students' perceptions, evaluations, and motivations of cheating and academic integrity, both in general and in the context of chemistry laboratory classrooms?
2. What are students' perceptions, evaluations, and motivations for hypothetical situations involving academic integrity in the chemistry laboratory classroom?

METHODS

Setting and Participants

This study took place at a large research university in the Midwestern United States. We recruited 24 students to participate in interviews. Students were recruited by contacting course instructors and asking them to send an email announcement to their students. The announcement included a link to a recruitment survey in which students indicated their interest in participating. Students who completed the survey were contacted for an interview. With the goal to capture a range of responses from students with various experiences, participants were purposefully sampled from the various general chemistry courses with a laboratory component at the institution, including Chemical Science (n = 4), General Chemistry (n = 15), General Chemistry and Qualitative Analysis (n = 4), and General Chemistry for Engineering (n = 1). These courses are predominately designed for first-year students. Chemical Science is taken by nursing students, General Chemistry and General Chemistry and Qualitative Analysis are taken by science majors (including chemistry, biology, premedicine, etc.), and General Chemistry for Engineering is taken by engineering students. Across the courses, the laboratory component follows a traditional structure where students complete prelaboratory activities, follow predetermined procedures with known outcomes during the laboratory, then complete postlaboratory activities. The laboratories are 2–3 h, and they are taught by graduate and upper-level undergraduate teaching assistants.

Participants included primarily first-year (n = 7) and second-year (n = 11) students, as well as third-year (n = 2), fourth-year (n = 2), and returning (n = 2) students. The participants represented majors across disciplines such as biochemistry, biomedical sciences, biology, psychology, and nursing. Participants indicated interest in pursuing further schooling (including medical school or graduate school) or directly entering the workforce (including nursing or industry) after completing their degrees. The majority of participants (n = 17) were enrolled in their first chemistry laboratory course, while the remaining participants had taken one previous chemistry laboratory course (n = 5) or two or more previous chemistry laboratory courses (n = 2). All participants received a $25 gift card incentive for participating in the study.

Data Collection

The data collected for this study comprised semistructured interviews with 24 student participants. The data collection procedures were approved by an Institutional Review Board, and all students provided verbal consent to participate. Before collecting the interview data, we conducted pilot interviews with 4 students to establish response process validity.[46] From the pilot interviews, we revised specific questions and prompts used in the interview protocol to clarify the intended meaning of the questions.

All interviews included in the analysis were conducted during the fall 2023 semester, and we continued conducting interviews until reaching saturation with student responses to the interview questions.[47] The interviews were audio recorded and transcribed verbatim. Pseudonyms are used when reporting student quotes.

Interview Protocol

The interviews began with an introduction to the study and verification of students' consent to participate. The interview protocol included two relevant sections: (1) two hypothetical scenarios involving academic integrity in the chemistry laboratory and (2) general questions about students' conceptions of cheating and academic integrity.

For the first part of the interview, students were presented with each scenario, both of which ended with an open-ended question about how students perceived the scenario's appropriateness. The scenarios were then followed with a discussion guided by specific follow-up questions which provided further and alternative contexts for the scenario to probe for students' evaluations and motivations. The first scenario stated,

"For each experiment in a lab course this term, students collect data with a partner, but they are expected to write the lab report independently. For one of the experiments, Ashley completed the data analysis and finished writing her lab report, when her lab partner, Jordan, asked if she could send the graphs from the data analysis for Jordan to use in their report. The TA won't know Ashley shared the graphs, since she and Jordan have the same data and would've used the same software and settings to make the graphs anyway. Would it be okay for Ashley to share the graphs she made? Explain your reasoning."

Follow-up questions for the first scenario included asking how the students' thoughts would change based on the amount of material shared (e.g., sharing the full lab report), the precedent for sharing materials in the course, and the relationship between the lab partners (e.g., being close friends). The second scenario stated,

"In one of the experiments for a lab course this semester, Joseph is having a hard time getting consistent data that is within the acceptable range given by the TA. Joseph only has one dataset that is relatively close to the expected values, and his lab partner says it will be okay to make up the rest of the data since at least one set is within the expected range. Getting the correct data is a relatively large portion of the grade for the lab report (about 15% of the grade). Joseph has been doing well in the class and wants to keep earning good grades so he won't have to stress about the final lab report. Would it be okay for Joseph to make up the data to fit the experiment? Explain your reasoning."

Follow-up questions for the second scenario included asking how the students' thoughts would change based on the student's grade in the course or if the situation occurred in a real-world laboratory instead of a classroom. For both scenarios, follow-up questions also probed for any other circumstances which might influence the students' opinions and for the student to summarize their overall impression of the appropriateness of the scenarios after discussing various circumstances.

For the second part of the interview, students were asked general questions focused on eliciting their perceptions of cheating and academic integrity. Questions included asking how students defined academic integrity and cheating, how academic integrity and cheating might apply to a chemistry laboratory setting, the reasons students (in general) might engage in cheating, and the ways instructors could support students to engage in academically honest behavior. For the entire interview, semistructured interview procedures were followed, allowing the researchers to ask additional or different probing questions based on the students' responses.

Data Analysis

We analyzed the data in two stages aligned with the research questions. For the first research question focused on how students conceptualize cheating and academic integrity, we qualitatively coded the portions of the interview with general questions about cheating and academic integrity. One researcher (FMW) engaged in constant comparison analysis by iteratively reading all interview transcripts, generating memos to capture variations in student responses, and inductively developing an initial coding scheme.[47] The coding scheme characterized (1) students' definitions of cheating and academic integrity, (2) students' understanding of how cheating or academic integrity could apply to the chemistry laboratory classroom, and (3) students' understanding of reasons for cheating. The unit of analysis was each response to the questions throughout the interview, and multiple codes could be applied to each unit of analysis. Two researchers (FMW and SCM) analyzed four interview transcripts with the coding scheme, discussed the codes, and calculated measures of inter-rater reliability. After coding the first interview, the researchers made modifications to clarify aspects of the coding scheme. For the remaining three interviews, the inter-rater reliability measures ranged between 74−90% agreement with K = 0.73−0.89 (using fuzzy kappa, which allows researchers to assign multiple codes to a single unit of analysis),[48] indicating moderate to strong agreement.[49] The researchers discussed their coding, finding that disagreements arose due to the complexity of the coding scheme rather than differences in interpretation of students' responses; thus, these agreement values were deemed acceptable. After finalizing the coding scheme, one researcher (FMW) coded the remaining transcripts. The coding scheme, with code definitions and exemplars, is available in the Supporting Information. After coding, the research team met to discuss the findings and identify themes regarding students' general perceptions of cheating and academic integrity, students' perceptions of how cheating and academic integrity applied to the chemistry laboratory classroom, and students' explanations of reasons for engaging in cheating behavior.

For the second research question regarding student responses to the hypothetical situations involving academic integrity, we used a profile-based qualitative analysis approach.[50] Specifically, one researcher (FMW) read all student responses to both scenarios and iteratively developed profiles to capture students' perceptions, evaluations, and motivations regarding the scenarios. While generating the profiles, the researcher additionally wrote memos to track common ideas and patterns in students' responses and categorized each students' response based on their overall perception to the two scenarios (with the possible categories being that the scenario was clearly cheating, did not seem like cheating, or ambiguous). To establish trustworthiness for this stage of the analysis, a second researcher (SCM) developed profiles and assigned categories for four students, after which the researchers discussed the profiles and any differences in key information included. After discussions focused on capturing all relevant information and appropriately assigning each response to a category, the first researcher revised the profiles as necessary for the remaining students. The second researcher then reviewed the remaining profiles alongside reading the interview transcripts. After all profiles were finalized, one researcher identified the key findings regarding the differences and similarities in the evaluations and motivations for the different categories of students, which were discussed by the full research team.

RESULTS

Research Question 1: What are Undergraduate Students' Perceptions, Evaluations, and Motivations of Cheating and Academic Integrity, Both in General and in the Context of Chemistry Laboratory Classrooms?

Across the interviews, students expressed largely similar conceptualizations of cheating and academic integrity, both in general and in the context of chemistry laboratory classrooms. The following sections provide an overview of the key findings extending from the thematic analysis of students' responses, which are summarized in Table 1. First, we describe students' general definitions of cheating and academic integrity. We then present findings regarding students' perceptions of cheating and academic integrity within the chemistry laboratory classroom. We conclude the section with our findings regarding the reasons students might engage in cheating behaviors for classroom activities including homework, exams, and lab reports. Altogether, the themes from this analysis provide a baseline for understanding students' perceptions, evaluations, and motivations related to cheating and academic integrity, both in general and in the context of chemistry laboratory classrooms.[16]

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Table 1. Overview of Students' Perceptions of Cheating and Academic Integrity in General and in the Chemistry Laboratory Classroom Context

General perceptions	Definition	Exemplar
Cheating	Using external resources or work produced by other students when not allowed by the instructor	"The first thing that comes to me is copying answers off of a test next to somebody or writing answers on your hand... it's using resources that other people don't have access to..." (Delores)
Academic integrity	Being honest with coursework, such as completing work independently and adhering to the rules for the course	"Just being honest on your work, following the guidelines and rules that are provided for you for the course..." (Robin)
Perceptions in the chemistry laboratory classroom context	**Definition**	**Exemplar**
Cheating	Copying other students' prelaboratory responses or results from the laboratory, or using external resources	"...with chemistry a lot of it is concepts, but also a lot of it is your math and your calculations, and I think it's really easy for people to just copy down other people's calculations..." (Kelsey)
Academic integrity	Not engaging in cheating behaviors, including participating in the laboratory (such as asking questions)	"I expect myself to know how to do the lab... when I'm doing the work, I'm trying to, instead of trying to lean on somebody to tell me everything, I'm trying to understand what I'm doing." (Kendall)

Students' General Perceptions of Cheating and Academic Integrity

Students commonly perceived cheating as completing coursework by utilizing either external resources or work produced by other students (n = 23 out of 24 students). For example, Darian stated that cheating is "any means to where you're using outside information, whether it's from a friend or online or just any kind of outside information that's not coming straight from your head... when you're taking a test or anything that's being graded." Students often, but not in all cases, qualified the use of external information with breaking the rules or expectations for the course (n = 12), as seen in Robin's response that cheating is "copying someone or something *that you know you should not be doing* or looking up answers *that is not academically appropriate*" (emphasis added). Infrequently (n = 4), students included that cheating is any action that benefits a student's grade but not their learning (e.g., Francis' statement that cheating is "using other resources that are going to benefit your grade but not necessarily benefit you") or that cheating is associated with not putting effort into a course (e.g., Allison's statement that cheating is "obviously not putting in effort").

Students largely perceived academic integrity as aligning with honesty and morality (n = 22). Students' discussion of honesty included the association between academic integrity and "being honest and being truthful" (Blair), as well as the idea of being honest about completing your own work, such as Jade's statement that academic integrity involves "using your own work and your own thoughts." Students also discussed the idea of morality, such as Steph likening academic integrity to "doing the right thing" and Delores discussing "doing schoolwork morally with a good moral compass." In addition to defining academic integrity with the ideas of honesty and morality, a subset of students discussed the relationship between academic integrity and adhering to the rules for a course (n = 5), such as Emerson's statement that academic integrity is "following all of the policies that are put out by your instructors." When prompted to describe the relationship between academic integrity and cheating, students generally (n = 22) perceived the two as opposites (such as Skyler's statement that "cheating is kind of the opposite of academic integrity"). Some of these students indicated that the relationship between the two concepts is not completely inverse. For example, Leigh stated that "they tie in closely with each other. It's kind of hard to put into words, but cheating goes into academic integrity." These sentiments suggest that students perceive academic integrity as a more expansive construct, a component of which involves avoiding cheating behaviors.

Students' Perceptions of Cheating and Academic Integrity in the Chemistry Laboratory Classroom

Students described that cheating occurs within chemistry laboratory course settings mainly through students copying one another (n = 17 out of 24 students), aligning with their general definitions of cheating. Students often specified this to the lab setting, such as Cam's statement that cheating would include "copying someone's answers to their pre-lab questions... or copying the results from the lab from somebody else." Some students also discussed using external resources (n = 6), such as Emerson's statement that cheating could include "Googling what should have happened in the lab." Infrequently, students described cheating in the chemistry laboratory classroom as not participating (n = 4), fabricating data (n = 3), and cheating on assessments associated with the lab course (such as lab quizzes or exams; n = 5). For example, Kendall explained how if "only one lab partner does the work and you just don't do anything, I feel like [that's] cheating as well." Another student, Regan, stated that cheating included "falsifying your data, asking somebody inside of the class to give you their data, coming up with a lab report and including conclusions and summaries and stuff that aren't actually yours." These students provided more specific examples which extended beyond students' general definitions of cheating to explain how cheating might occur in a laboratory course.

When prompted to explain how academic integrity applies to a chemistry laboratory course, most students responded by describing actions that were the opposite of cheating behaviors (n = 18). For example, Avery stated, "I guess being there every lab and doing the work yourself and asking questions, making sure you have correct data so you can properly do the lab report." Like Avery's sentiment about asking questions, a subset of students similarly discussed that academic integrity applied to the laboratory course by getting help and communicating with the instructor (n = 5). For example, Allison explained the importance of "being honest with your TA," and Brook stated that academic integrity includes "making sure that you're understanding the material and going to things like [supplemental instruction] and tutoring and just not cheating." These students' descriptions of academic integrity demonstrate tangible ways that acting

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with academic integrity can be more expansive than simply avoiding cheating behaviors.

Students' Motivations for Engaging in Cheating Behavior

Students reported various reasons for why students, in general, might engage in cheating behavior (Figure 1). These reasons

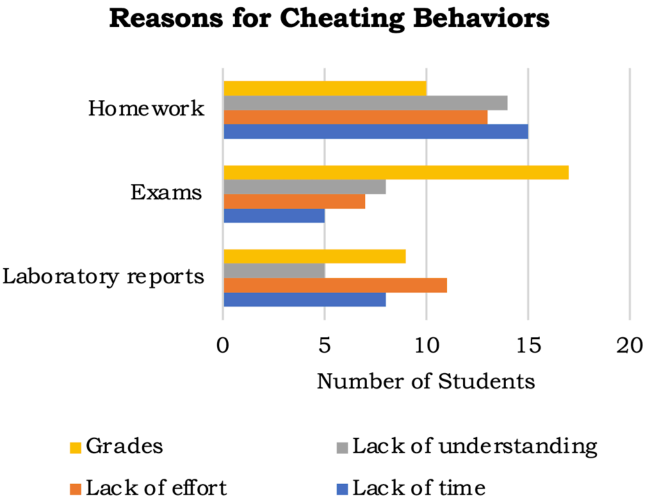

Figure 1. Students' reported reasons for engaging in cheating behaviors on homework, exams, and laboratory reports.

for cheating largely align with different motivational factors which influence students' decisions to act with integrity.[16] The most cited reasons were lack of time, lack of understanding, lack of effort, and pressure for good grades. When asked about why students might cheat on homework specifically, students discussed time constraints, lack of understanding, and lack of effort as reasons for cheating slightly more often than discussing the pressure for grades. For exams, students' predominant reason for cheating was grade pressures, with students also discussing lack of understanding, effort, and time in addition to a lack of preparation or general feelings of anxiety or stress. For lab reports, students discussed time, effort, and grades more often than they discussed a lack of understanding. When probed to describe additional reasons for why students might cheat across types of assignments, students reported social reasons (including work, family, or other priorities), anxiety and stress, peer pressure, and lack of resources. Exemplar quotations for each of these factors are provided in the coding scheme within the Supporting Information. Notably, students' responses consisted entirely of motivational factors (i.e., concerns which conflict with acting honestly) rather than evaluative factors (i.e., contexts which influence whether behaviors are perceived as cheating).[16] The absence of evaluative factors likely relates to the nature of the question ("What are the main reasons a student might cheat on a homework assignment?"), which did not prompt students to consider context-specific factors which may influence their perceptions of cheating behaviors as no longer cheating.

Research Question 2: What are Students' Perceptions, Evaluations, and Motivations for Hypothetical Situations Involving Academic Integrity in the Chemistry Laboratory Classroom?

Despite providing similar baseline perceptions of cheating and academic integrity (both in general and in the context of chemistry laboratory classrooms), students demonstrated more variation in their perceptions, evaluations, and motivations of hypothetical, ambiguous scenarios related to common events which may occur in the laboratory classroom setting. In the following paragraphs, we describe students' varying responses to the two scenarios. Representative profiles for students' responses to each scenario are provided in the Supporting Information.

Scenario One: Sharing Graphs

For the first scenario, students were presented with a situation in which a student's lab partner asked them to share the graphs they generated independently. The scenario included the notion that the lab instructor would not know they shared the graphs because they would look the same due to being based on the same data. The students were divided in their perceptions of the scenario, with 9 students indicating that the scenario was clearly cheating, 10 students indicating that the scenario did not seem like cheating, and 5 students indicating that the scenario might or might not be cheating (Figure 2).

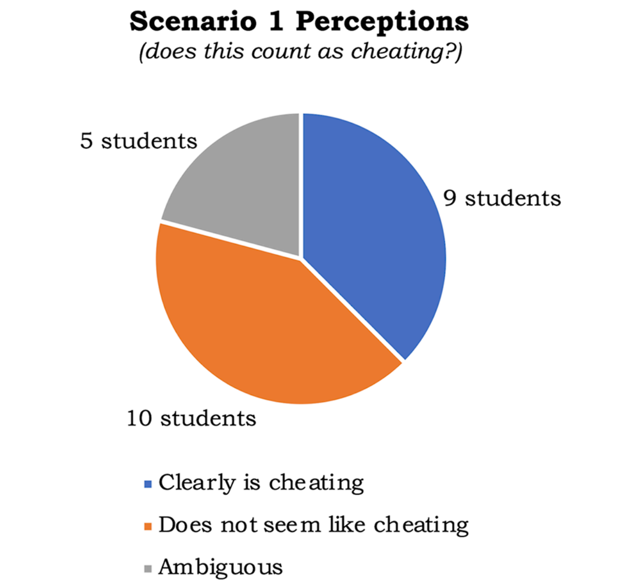

Figure 2. Students' perceptions for the first hypothetical scenario.

The students who perceived the situation as clearly cheating focused their discussion on the rules of the laboratory and how providing the graphs in the scenario might interfere with the lab partner's learning. Specifically, these students focused on the framing of the scenario which stated that students "are expected to write the lab report independently," leading to the interpretation of the scenario as clearly cheating because the graphs were an independent portion of the lab report. In addition, these students discussed how the lab partner should produce their own graphs to learn that skill. A subset of these students did provide the evaluation that it could be acceptable to share the graphs in the context of helping the lab partner generate their own graphs.

For the students who perceived that the situation did *not* seem like cheating, the focus was on the idea that the graphs would ultimately be the same (due to the data being shared between lab partners) and that the graphs do not require as much intellectual work compared to the other aspects of the lab report. Similar to the group who thought the scenario was clearly cheating, these students also discussed their evaluations

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Table 2. Common Evaluations and Motivations across Groups (Clearly Is Cheating, Does Not Seem Like Cheating, Ambiguous) Regarding the First Scenario

Evaluations—contexts that influence cheating behaviors	• Clarity of rules/instructions for the lab • The effort it takes to produce the graphs • Whether making graphs was a learning objective • Whether sharing the graphs would be accompanied by helping the lab partner learn how to make the graphs on their own
Motivations—concerns that conflict with acting honestly or dishonestly	• The lab partner's level of effort and how closely they worked together during the lab • The nature of the relationship between lab partners (e.g., negative prior experiences versus being close friends) • Whether the lab partner frequently asked to share materials (versus the request being a one-time instance) • The risk of being caught

based on the clarity of instructions for the lab. These students' discussion of the unclear instructions suggests an underlying view that the graphs are essentially equivalent to the data recorded during the collaborative portion of the experiment, and thus it is acceptable to share graphs between lab partners. A subset of these students discussed that sharing the graphs would be good because it is valuable to collaborate in the lab environment, suggesting a possible motivational influence due to the social context of the classroom laboratory.

The students who perceived the situation as ambiguous did not make a clear decision when initially prompted to discuss whether the situation was appropriate or when prompted at the end of the discussion to summarize their thoughts about the scenario. For these students, their perceptions of the appropriateness of the situation were dependent on the evaluations of circumstantial factors, to the degree that they did not make a definitive overall decision about whether the situation was cheating or not cheating. Specifically, these students discussed various factors that would influence their evaluation of the scenario as either cheating or not cheating, many of which were also discussed by students belonging to the other groups. These common factors influencing students' evaluations and motivations across groups are detailed in Table 2. Evaluations typically regarded the clarity of instructions or learning goals for the laboratory, while the motivations typically regarded concerns related to the social context of interacting with the lab partner. In follow-up questions altering the context of the scenario (e.g., asking what students would think if the scenario involved a close friend with a family emergency), these evaluations and motivations often influenced students to provide an alternative response compared to their perception of the base scenario (e.g., some students who perceived the base scenario as clearly cheating indicated that it could be acceptable under the circumstance of sharing graphs with a close friend that has a family emergency).

Scenario Two: Fabricating Data

For the second scenario, students were presented with a situation in which a student was having difficulties getting consistent data, and their lab partner suggested making up data to match the expected outcome and complete the experiment. The scenario included the caveat that getting the correct data was worth a relatively large portion of the grade for the lab report, but that the student was doing well in the course overall. Similar to the first scenario, students were divided in their perceptions, with 13 students indicating that the scenario was clearly cheating and 11 students indicating that the scenario might or might not be cheating (Figure 3).

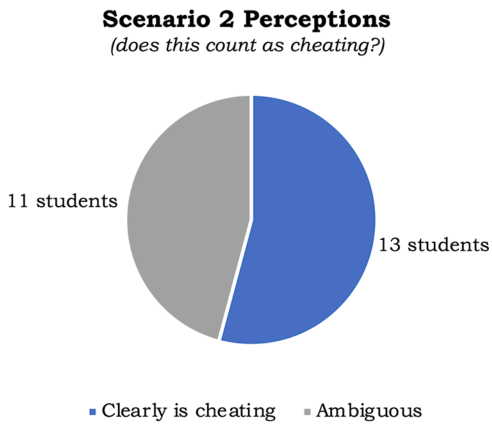

Figure 3. Students' perceptions for the second hypothetical scenario.

The students who perceived the situation as clearly cheating indicated the view that fabricating data was unacceptable under any circumstance. In contrast, the students who perceived the situation as ambiguous indicated that although they know it is wrong to fabricate data, they understood why a student might do so under specific circumstances. Both groups of students provided the evaluation that the student within the scenario should respond in other ways instead of fabricating data, such as discussing their difficulties with the teaching assistant, repeating the experiment, or explaining what went wrong with the experiment in the lab report. However, when discussing the scenario further, the students who perceived the scenario as ambiguous discussed evaluations of the scenario in which it would be acceptable to fabricate data, including the idea that it is acceptable to fabricate the data as a last resort (Table 3).

Students in both groups discussed motivational factors which would push them away from engaging in cheating behavior, all related to the consequences of fabricating data. Students discussed that fabricating the data may interfere with completing the postlab questions (i.e., if the fabricated data does not align with realistic data), or that it might be obvious to the teaching assistant if the data were fabricated. Students also discussed that fabricating the data may lead to difficulties later in the course (or in future courses) where they need to know how to appropriately collect data for this type of experiment. Students who perceived the situation as ambiguous noted additional motivations which would conflict with acting honestly, which related to pressures involving grades and time (Table 3). Notably, when prompted about whether similarly fabricating data would be acceptable in a "real-world" laboratory, students from both groups explained

Table 3. Evaluations and Motivations for the Students Who Perceived the Second Scenario as Ambiguous

Evaluations—contexts that influence cheating behaviors	• Availability of resources (e.g., teaching assistant support)[a]
	• Ability to repeat the experiment[a]
	• The option to explain what went wrong with the experiment in the lab report[a]
	• Acceptable as a last resort
	• Acceptable as long as the student understands the content
	• Acceptable if the student only fabricates a single data point
Motivations—concerns that conflict with acting honestly or dishonestly	• Consequences of fabricating data (e.g., ability to do the postlab; may need the knowledge of how to appropriately gather the data later in the course)[a]
	• The risk of being caught[a]
	• Grades (more incentive to fabricate data if the lab is worth a larger portion of the course grade)
	• Frustration with the experiment (e.g., already repeated the experiment and running out of time)

[a]Evaluation or motivation shared by students who perceived the scenario as clearly cheating.

that the scenario would be unacceptable due to the higher stakes in an authentic, "real-world" lab.

Trends across the Two Scenarios

Examining each student's responses to the two scenarios, there was notable overlap in how students characterized each scenario as clearly cheating, not clearly cheating, or ambiguous (Figure 4). Specifically, 7 (out of 9) students who responded

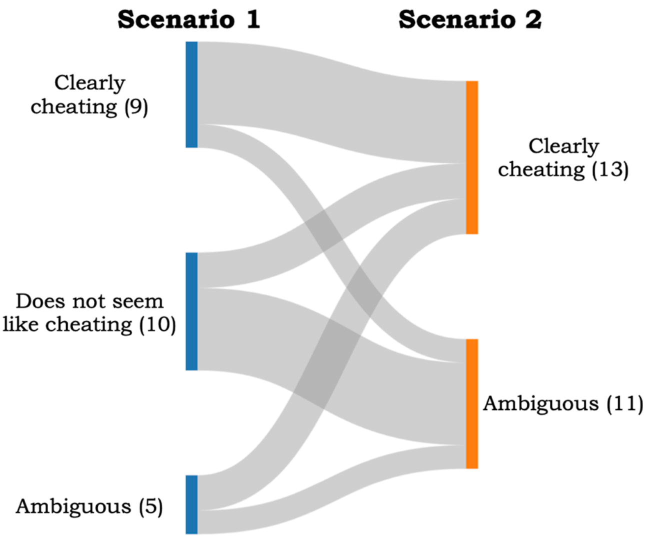

Figure 4. Sankey diagram demonstrating students' responses to the first scenario (left) and how the same students responded to the second scenario (right). Diagram created using SankeyMATIC.

that the first scenario was clearly cheating similarly responded that the second scenario was clearly cheating. Furthermore, 7 (out of 10) students who responded that the first scenario did not seem like cheating responded that the second scenario was ambiguous.

While the small sample size and the use of only two scenarios precludes us from making definitive claims, the overlap in responses to each scenario for these two groups of students suggests the possibility of an underlying viewpoint on academic integrity in the chemistry laboratory classroom. Specifically, the students who viewed both scenarios as clearly cheating appeared to identify that engaging in the behavior would import a high impact on learning for the students involved in the scenario. For example, in Skyler's response to the first scenario, they said that it would be okay for the student to help their lab partner construct their graphs (rather than only sharing the graphs) "if it was clear that [the lab partner] was putting in the effort and trying to understand." In Skyler's response to the second scenario, they said that they "don't really think it would be okay [to fabricate data] because then he's not understanding the material." In contrast, the students who perceived the first scenario as not cheating and the second scenario as ambiguous appeared to identify that engaging in the behaviors would have low impact on learning. For example, in Dakota's response to the first scenario, they indicated that the situation was not clearly cheating "because they are collecting the same data and making the same graph... it's good to share the graph so that they can help each other and make the lab report as efficient as possible." In their response to the second scenario, Dakota indicated that fabricating data would be okay "as long as they know the error and the problem that caused those kind of things to happen." For all students, the perceived impact on learning appeared to be moderated by evaluative and motivational components (most commonly involving grades, social concerns, and time) which influenced their ultimate response to the given scenario (Figure 5).

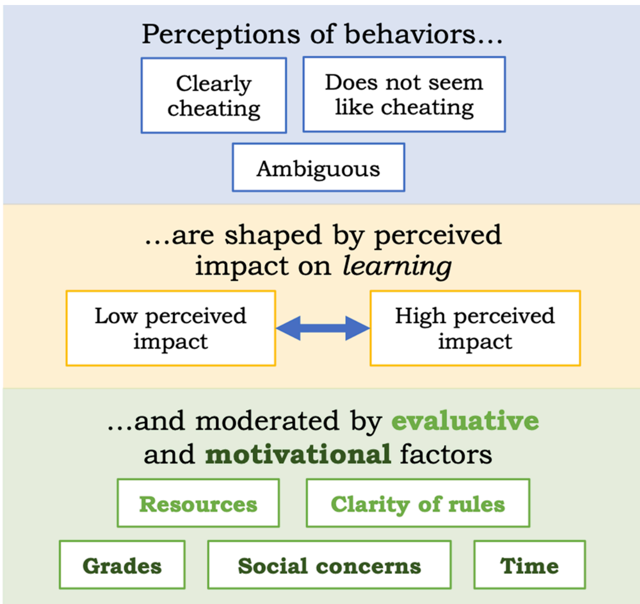

Figure 5. Possible underlying evaluative and motivational factors shaping students' perspectives on cheating behaviors in the chemistry laboratory classroom.

■ DISCUSSION

Findings from the first research question demonstrate that students tend to hold rather uniform perceptions of cheating and academic integrity, both in general and in the context of chemistry laboratory classrooms. Overall, students' perceptions were largely normative and aligned with how an instructor might perceive cheating (such as using external resources and breaking course policies) and academic integrity (such as

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seeking help through course resources). The lack of variation in students' perceptions aligns with prior research[30] and may relate to the boilerplate, nonspecific language often used for discussing academic integrity in chemistry syllabi.[33] The normative nature of students' perceptions (even with the possibility that students responded with socially desirable answers)[41] suggests that students do have a baseline understanding of what constitutes cheating behaviors. Furthermore, students are able translate this baseline understanding into the chemistry laboratory classroom context, as demonstrated by some students' ability to provide specific examples of how their normative definitions of cheating can apply to the lab context. However, few students provided more laboratory-specific examples (such as fabricating data), aligning with findings from prior research that students face difficulties with understanding how academic integrity can apply to the lab environment.[37]

In contrast to the general uniformity of students' responses in the findings for the first research question, students demonstrated greater variation in their perceptions, evaluations, and motivations related to the two hypothetical scenarios for the second research question. Specifically, students appeared to consider the perceived impact of cheating behaviors on learning, and students who perceived a low impact on learning appeared more likely to evaluate a specific cheating behavior as acceptable. In contrast, students who perceived a higher impact on learning appeared more likely to evaluate the specific cheating behavior as unacceptable. Nevertheless, students' perceptions for specific scenarios were moderated by contextual factors, such as grade pressures, social relationships, and time constraints. In contrast to prior research focused on identifying demographic factors associated with self-reported cheating behaviors,[12−15] our findings indicate the nuances associated with cheating and the relationship to how students perceive cheating as impacting their learning. Differences in how students perceive the impact on learning and weigh evaluative and motivational factors suggest the need for increased clarity regarding how students should respond to scenarios which may involve cheating behavior. Considered through the lens of social desirability bias,[41] the findings from the second research question lead to similar conclusions: that is, if we assume that students are providing the socially desirable response for the two scenarios, students nevertheless hold different perceptions of what response aligns with the socially desirable response, suggesting a lack of clarity for how students should approach ambiguous situations involving academic integrity.

Considering the existing literature related to cheating and academic integrity, our findings demonstrate key similarities to prior research while providing additional insights. Building on the prior chemistry education literature primarily focused on instructional approaches to maintain academic integrity during the COVID-19 pandemic and with emerging technologies,[7,8,10,11,29] our findings emphasize the importance of considering the contextual factors that influence students' perceptions of cheating behaviors. Contextual factors can include those which influence students' motivations (i.e., external concerns which conflict with acting honestly) as well as those which influence students' evaluations of cheating behavior (i.e., contexts that effect whether students perceive an action as cheating). Similar to prior research based on students' meaningful learning in the chemistry lab,[51] our findings suggest that motivations such as grade pressures and lack of time can disincentivize learning and provide reasons for students to engage in cheating behaviors. Building on this research, our findings additionally indicate the importance of students' evaluations of cheating behaviors; specifically, students may view certain behaviors as cheating in some contexts but not others. Altogether, our findings suggest the importance of centering discussions focused on academic integrity within the context of the chemistry laboratory classroom. Because the classroom laboratory is a space where students first gain exposure to scientific research practices, centering academic integrity will emphasize the importance of applying ethical considerations as a feature inherent to the practice of science.[35]

IMPLICATIONS

Implications for Instruction

The findings indicate that students may engage in cheating behaviors because they perceive that such behaviors may have a low impact on their learning. Students may also engage in cheating behaviors when their perceptions shift due to contextual factors, such as the pressure for good grades, lacking time to complete an assignment, or helping a friend. To address these concerns and better support students with making academically honest decisions, instructors can clarify the learning objectives for classroom activities and provide transparency about how engaging in activities provides students with opportunities to learn. For example, students may not understand how creating graphs from collected data is a skill that needs to be practiced. Alongside clarifying learning objectives, instructors can clarify what counts as cheating, even for behaviors which may seem to be obviously cheating from an instructor's perspective (such as fabricating data). Instructors should emphasize the importance of engaging in ethical behavior within the classroom laboratory context so that students can build a sense of ethics to bring with them into their careers.

In addition to clarifying learning objectives and what counts as cheating, instructors can also consider ways to mitigate the contextual factors that may shift students toward cheating. For example, instructors can consider options to shift students' motivations in the course from obtaining a grade to learning, which could be supported by making students' grades in laboratories based on their participation and explanations rather than whether students obtained the expected results. Instructors may also consider setting guidelines for how students can help one another learn. For example, rather than prohibiting sharing materials such as graphs produced for a lab report, instructors may instead provide structures where students can help one another through the process of producing the graphs. Lastly, instructors could provide resources to students (or direct students toward existing resources) so that students can be supported with meaningfully engaging with assignments rather than resorting to cheating behaviors.

Implications for Future Research

The findings from this study provide a starting point for future research focused on supporting students to act with academic integrity in the chemistry laboratory classroom. For example, future studies could further explore the potential underlying evaluative and motivational factors shaping students' perspectives on cheating behaviors as they relate to students' perceptions of the impact of cheating on learning. Further research to develop this hypothesis can provide avenues for

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developing instruments and surveys to more broadly characterize students' views on cheating and academic integrity in the chemistry laboratory classroom context, which could allow for longitudinal or cross-sectional studies examining students' views as they gain increased experience in teaching laboratories. Additionally, future research can explore interventions focused around centering academic integrity in the chemistry laboratory and understanding how such interventions may shape students' perceptions. Lastly, as the findings from this study demonstrate the importance of context on students' perceptions of cheating and academic integrity, future research should investigate student perceptions in the context of course-based undergraduate research laboratories or mentored undergraduate research experiences. Because these chemistry laboratory spaces are training environments with the simultaneous goals for students to learn chemistry concepts and laboratory techniques while generating new knowledge (as opposed to replicating expected results),[52] student perceptions of cheating and academic integrity may differ than their perceptions in the context of traditional classroom laboratories.

LIMITATIONS

Findings of this study are limited by the qualitative nature of the research. Specifically, the findings are not intended to be generalizable to populations of students at other institutions. However, we have made efforts to provide rich descriptions of our context and findings so readers can understand how the findings might apply to their own institutional contexts. In addition, students volunteered to participate and received a gift card as compensation, which may have contributed to self-selection bias. Furthermore, while efforts were taken to mitigate and consider the influence of social desirability bias, it nevertheless poses a limitation to the study, particularly when considering the distribution of participants' responses to the hypothetical scenarios. While we examined student responses to two different hypothetical scenarios, the claims from this study are limited in that students likely hold different perceptions, evaluations, and motivations for other scenarios they might face. Furthermore, students' responses to the hypothetical scenarios may differ from how they might respond to authentic scenarios due to the importance of contextual factors on how students make decisions about engaging in cheating behaviors.

CONCLUSION

For this study, we interviewed students regarding their perceptions of cheating and academic integrity, both in general and in the context of chemistry laboratory classrooms. Additionally, we presented students with hypothetical scenarios involving academic integrity to gauge their perceptions, evaluations, and motivations for different situations which might occur in a classroom laboratory. The findings suggest that (1) students have declarative knowledge of academic integrity and what constitutes cheating behavior, but (2) students exhibit different responses when applying their understanding of academic integrity principles to hypothetical, ambiguous scenarios. The hypothetical scenarios, and their ambiguity, more likely reflect authentic scenarios where students must make decisions regarding academic integrity within chemistry laboratory classrooms. The fact that students varied in their perceptions, evaluations, and motivations of these scenarios suggests a need for instructors to provide more guidance about academic integrity principles and how to uphold academic integrity within the classroom laboratory. More guided, specific instruction about academic integrity is especially important in the laboratory setting, where students are gaining hands-on experience related to research and scientific practices.

ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available free of charge at https://pubs.acs.org/doi/10.1021/jacsau.4c00227.

Coding scheme and representative profiles (PDF)

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Author Contributions

The manuscript was written through contributions of all authors. CRediT: **Field M. Watts** conceptualization, investigation, methodology, visualization, writing-original draft, writing-review & editing; **Slade C. McAfee** writing-original draft; **Jon-Marc G. Rodriguez** conceptualization, methodology, resources, supervision, writing-review & editing.

Notes

The authors declare no competing financial interest.

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