Introduction

Not many of you should presume to be teachers, my brothers, because you know that we who teach will be judged more strictly. – James 3:1

Teachers have an extraordinary responsibility—to prepare individuals for the life challenges that come with maturity. Our main obligation is to create environments where our students will be transformed into innovative and productive contributors to society. This is, in essence, a social contract between teachers and the greater community. It is our duty to prepare and instruct students in a proper manner to prepare them for life’s challenges. Professors have a set of moral obligations that must be maintained as a public figure at a higher institution of learning. We declare our ethics and ideals through our actions and behavior in our classrooms, laboratories, and offices. We are mentors and confidants to our students, which includes the responsibility of being a role model. It is important that professors have a reputation that does not hinder our goal of developing students into our future leaders and contributors to society.

Learning the language

Now go; I will help you speak and will teach you what to say. – Exodus 4:12

In the Old Testament, Moses is portrayed as a reluctant leader that needed God’s help with the immense task of leading God’s people out of Egypt. Moses claimed that he was unqualified to lead God’s people because of his inability to speak articulately. God helped Moses with this weakness, telling him what to say to the Israelites (through his brother Aaron), and is now recognized as one of the greatest leaders mentioned in the Bible. My role as a professor is to teach my students “what to say”—providing them with a solid curriculum and framework of knowledge. For many students, learning chemistry is similar to learning a new language. Students will enter the classroom with some established vocabulary (Tier 1 in Figure 1), which include simple, everyday words (e.g., liquid). They may even have some vocabulary that is slightly more sophisticated (Tier 2) that is related to chemistry, but may have been used in other contexts (e.g., calibrate). However, to get students to speak this new language fluently, they will need the most help learning the domain-specific words (Tier 3) associated with the discipline (e.g., spectrophotometry).

![Figure 1. Tiered vocabulary, described by Beck et al.](image)

One danger of learning the domain-specific academic vocabulary is to equate simple memorization of terms and definitions with comprehension.² A regurgitation of equations and terms is not the best way for a student to learn chemistry. Students should question, analyze, and test their newly acquired knowledge through different mechanisms. This can be done through regular out-of-class assignments (“homework”), which should motivate the student to remain immersed in the material. Out-of-class assignments give the instructor well-timed feedback that can be used to monitor performance and determine strengths and weaknesses of students. The use of online homework systems provides today’s students with immediate feedback as they attempt to master course content. However, it is important to encourage students to work on their out-of-class activities using pencil-and-paper prior to inputting their electronic responses. A recent study in the Journal of Chemical Education supports this approach; students performed better on examinations using this method.³

Learning the skills

Bless all his skills, O LORD, and be pleased with the work of his hands. – Deuteronomy 33:11a

As Moses blessed the twelve tribes of Israel just before his death, he consecrated the tribe of Levi for their skills and handiwork. The ability to work with one’s hands has been important since the first hunters and gatherers. In Ken Bain’s seminal publication What the Best College Teachers Do,⁴ he outlines 13 questions that you should consider when planning a course. The first question in his list follows: What big questions will my course help students answer, or what skills, abilities, or qualities will it help them develop, and how will I encourage my students’ interest in these questions and abilities? When thinking about the skills and abilities to learn in chemistry, one naturally considers the laboratory setting. It is important that students learn how to use the specific tools (e.g., pipets, burets, volumetric glassware) to enhance their experience and knowledge. In the laboratory setting, students get an opportunity to learn skills that are used beyond the walls of the institutional laboratory. For example, water treatment technicians use basic titrations and pH measurements to monitor the remediation process. Another important goal in the laboratory is to teach concepts. Because of this, it is important to coordinate the topics taught in the laboratory with those in the lecture, a common method in most institutions.⁵ The skills that students learn in the laboratory setting can be translated to the research laboratory. To develop genuine research scientists, a professor must commit to a mentor-apprentice relationship with his or her students. In my opinion, this type of relationship is the best way to teach a student. The well-known proverb holds true: Give a man a fish and you feed him for a day. Teach a man to fish and you feed him for a lifetime.⁶ We must teach our students how to conduct proper research to continue scientific discovery for the generations to come, just as our mentors taught us. To this end, it is important that the professor stay active in his or her research

² Talanquer, V. “Chemistry Education: Ten Dichotomies We Live By” Journal of Chemical Education 2012, 89, 1340-1344.
field. We must actively use the scientific method to find new and innovative discoveries in our
field of interest if we are to be called scientists.

One of my goals is to give my students the tools to be able to learn new things on their
own. There are numerous benefits in becoming lifelong learners, and we as teachers are
uniquely positioned to help our students achieve this ability. One pedagogical tool to help our
students become independent learners is utilizing active-learning strategies in the classroom.
Active-learning strategies involve students engaging in activities that promotes synthesis and
analysis of course content instead of merely accepting information in a passive manner. In the
realm of chemistry, an important active-learning tool is Process Oriented Guided Inquiry
Learning (POGIL). POGIL uses guided inquiry to help students (in small groups) work through
targeted questions and activities to learn course content. Here, the teacher plays the role of guide
more than that of expert. Every student in the group has a role (manager, recorder, spokesperson, and reflector). These roles are rotated among the group, giving each student an
opportunity to develop their interpersonal skills and to leverage his or her strengths in a
particular role. Using this methodology, students are more engaged in the learning process.

Learning the necessities

*Instruct a wise man and he will be wiser still; teach a righteous man and he will add to his learning.* – *Proverbs 9:9*

King Solomon, author of this proverb and unquestionably the wisest king of ancient
Israel, knew the importance of continuous education to be successful in life. Students need more
than mastering chemistry in preparation for their future careers. Teachers are bound by a social
contract to prepare students for their future. This includes preparing students that may not
continue in a career directly aligned in the chemistry field.

The National Association of Colleges and Employers (NACE) defines career readiness as
“the attainment and demonstration of requisite competencies that broadly prepare college
graduates for a successful transition into the workplace”. These competencies are listed in
Figure 2 below.

![Figure 2. NACE Competencies for Career Readiness](image)

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8 Process Oriented Guided Inquiry Learning website.
9 National Association of Colleges and Employers. “Career Readiness for the New College Graduate: A Definition and Competencies”
In my classroom, students get experience related to these competencies in a variety of ways. For example, the analysis of experimental data, the perusal of previous research, and the ability to make decisions are skills that foster the development of critical thinking and problem solving. The ability to decipher problems from more than one approach, even if different from the professor’s preferred method, is important. The ability to express your ideas and results with others is vital in the workplace. Oral communication can be refined through formal presentations and oral examinations. In the classroom, simply asking students to answer questions with thoughtful, well-supported statements can also develop their oral communication skills. Writing a clear and understandable report, as well as using software programs for word processing and data analysis, can be improved through the preparation of laboratory reports. Additionally, encouraging students to use emerging (and established) technology during their college career is important. For example, students in my courses will use spreadsheet software to make graphical representations of data. Learning how to use this type of software is beneficial for them, whether they continue in the sciences or simply want to manage their personal budgets. Students learning to work together will develop the ability to collaborate with others in team settings, as well as determine what strengths they contribute to a particular group. In the laboratory setting, the Cooperative Chemistry method is used to develop student collaboration. Using this pedagogy, students in groups of four are each assigned a role (leader, communicator, record keeper, and counselor) that is rotated throughout the course. The rotation provides each student an opportunity to work on skills that will help them be better prepared for their future career.

Learning the styles

There are different kinds of gifts, but the same Spirit. – 1 Corinthians 12:4

It is evident that students have different characteristics, traits, and learning styles. There are eight learning styles proposed by neuroscientist Howard Gardner (Figure 3). The challenge for any professor is to teach students that exhibit more than one primary learning style in a single classroom. For example, verbal-linguistic students absorb information by engaging with reading materials and by discussing and debating ideas. Alternatively, visual-spatial students learn the most from pictures, diagrams, and other visual aids (e.g., animations and videos). Even though there is a natural propensity to teach to my own primary learning style (visual-spatial) in the classroom, being aware of the different learning styles of my students is essential. For my verbal-linguistic learners, using the whiteboard to explain concepts and working through example problems and calculations is beneficial. Typically, students are receptive to professors who lecture in a dynamic fashion (using gestures and intonation) and tell humorous stories, especially those where the professor is the victim of the humorous anecdote. Professors can also build credibility by sharing personal experiences that have applications to concepts being taught in the classroom. These personal experiences are a benefit to a verbal-linguistic learner, who is more likely to remember a particular concept by relating it to a professor’s story. Bodily-kinesthetic learners benefit from demonstrations in the classroom and hands-on experiences in the laboratory setting. They appreciate a professor who is animated and uses body language for emphasis when explaining key concepts. For my instrumental analysis course, students learn

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how to build models of analytical instruments using a “cut-and-paste” method.\textsuperscript{11} This tactile way of learning is great for bodily-kinesthetic learners. While it is difficult to give equal time for each of these learning styles in the classroom, being attentive to the learning differences of my students is important.

<table>
<thead>
<tr>
<th>Learning style</th>
<th>These students learn best by …</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal-Linguistic</td>
<td>Reading, writing, listening, and speaking.</td>
</tr>
<tr>
<td>Logical-Mathematical</td>
<td>Classifying, categorizing, and thinking abstractly about patterns, relationships, and numbers.</td>
</tr>
<tr>
<td>Visual-Spatial</td>
<td>Drawing or visualizing things using the mind’s eye.</td>
</tr>
<tr>
<td>Auditory-Musical</td>
<td>Using rhythm or melody, especially by singing or listening to music.</td>
</tr>
<tr>
<td>Bodily-Kinesthetic</td>
<td>Touch and movement.</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>Relating to others by sharing, comparing, and cooperating.</td>
</tr>
<tr>
<td>Intrapersonal</td>
<td>Working alone and setting individual goals.</td>
</tr>
<tr>
<td>Naturalistic</td>
<td>Working with nature.</td>
</tr>
</tbody>
</table>

*Figure 3. Multiple intelligences, or learning styles, proposed by Gardner.*\textsuperscript{12}

The ultimate goal of education is learning, not teaching. Teachers are to challenge their students vigorously and fairly. Teachers should treat students as responsible adults, regardless of cultural or socioeconomic background. Teachers should show that they care for their students as well. Simply calling students by their first name shows that there is some connection to the emotional aspect of the teacher-student relationship. Teaching in a residential, liberal arts setting gives the professor a better opportunity for a personal connection with the student.\textsuperscript{13} With students living in close proximity to the academic buildings, there is a greater chance for community, which is undoubtedly a benefit of the residential, liberal arts college.