Have things changed in 25 years?

This excerpt was taken from the October/November 1986 issue of *Chem 13 News,* pages 10-11. It is a selection from a reprint from a then-to-be published textbook entitled *Heath Chemistry (1987).* This textbook carried an excellent section on the philosophy of teaching high school chemistry in the Teacher's Annotated Edition. We selected this reprint because we were curious if things have changed in our teaching in the last 25 years. Curiously, the article begins with stating there has been little change to the previous thirty years. Do you have an opinion on how things have changed in teaching high school chemistry? Should some reasons be removed or added to this list? Or are these the hurdles students will always face in the transition from high school to college/university? We would love to have a discussion on this. Send in your comments to share with *Chem 13 News* readers (email Jean Hein, jhein@uwaterloo.ca).

Why students fail in college

During the past thirty years, there has been little change in the reasons that college students fail.

1. College students fail because they are unprepared to assume responsibility for their own learning. They have not learned to manage time. They do not discipline themselves to study. Students have difficulty deciding whether they understand what is expected. Then they are not sure where to find the information that they need, or how to separate misleading or irrelevant information from that which is pertinent. They have difficulty synthesizing information from several sources and bringing it to bear on the program. Assignments may simply go undone.

2. Many college students have poor communication skills. They are unable to interpret tables, diagrams, graphs, mathematical expressions, and specialized languages such as chemical equations. They express their own ideas ambiguously. Their writing often is poorly organized, grammatically incorrect and riddled with contradictions.

3. Students lack originality. Although skilled at memorizing, applying specified algorithms in a routine manner, and repeating what they are told, they are stumped by novel tasks for which they have been given no algorithm. In addition, few students show an ability to evaluate facts, directions, or other information.

4. Students lack flexibility. Anyone can learn from a gifted teacher in a supportive environment, but colleges have many intelligent professors who are poor teachers and who provide weak learning environments. Success depends on the ability to use unlikable people in poor instructional environments to acquire useful knowledge.

When these causes of college failure are equated with the goals of chemistry teaching, there is cause for jubilation as well as despair; jubilation because the competencies that are needed for success in college are those needed for success in everyday life; despair because so little teaching is directly related to these competencies.

In writing this book, our goal has been to provide you with a tool that you can use to help students develop those competencies required for success, either in continued education or in the everyday world. Then how is this book different from others that you have read?

Most chemistry texts required students to memorize words used by scientists to describe the natural world, but the meaning of those words is often unclear. Students are taught algorithms to solve routine problems encountered in chemistry, but little attention is given to why a rule or algorithm will produce a right answer. It often is difficult to see how the algorithms taught in school apply to the problems we encounter in everyday life. Because the logic behind the algorithm or rule is not understood, any novel problem or exercise is incomprehensible, and the student fails.

In this text, students are guided to understand why a rule or algorithm can be used to solve a problem. Proportional reasoning, which is at the root of most chemistry concepts and computations, is emphasized throughout the text. Students who learn how to use proportional reasoning are far better prepared to understand chemical concepts or other complex ideas than are students who only memorize definitions and arbitrary rules.

The development of proportional reasoning or other reasoning skills requires time and practice in a variety of contexts. Consequently, fewer topics can be treated in a course designed to develop such intellectual skills. There is more material in this text than the average student will be able to understand in the time available. You will need to select those topics that lend themselves to the development of important reasoning skills. We have listed topics and chapters that we consider to be optional, but you must make the final decisions after considering the ability of your students and local educational needs.

Many teachers worry about omitting topics that they know students will encounter in later courses or that relate to issues of general interest. Experience has shown that focusing on thorough comprehension of a few basic concepts facilitates understanding other concepts in later courses or in application to everyday experience. Conversely, the cursory treatment of many topics hinders understanding of the logic inherent in mathematical and chemical language, of chemical computations, and of mental constructs such as the atomic model that chemists use to think about chemical changes. ■