Online Chemistry Help Service in Non-majors General Chemistry

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Introduction

Chemistry 110 at Illinois State University (ISU) and Northern Illinois University (NIU) are non-majors introductory chemistry courses. Students and instructors meet 3 hours per week for lecture and most students are enrolled in a separate one-hour laboratory course. Students taking the courses need some fundamental chemistry background in typical topics such as stoichiometry, atomic structure, acids & bases, equilibrium, etc. Most students are expected to use this knowledge in majors such as nursing, agribusiness, and industrial technology.

For the past year, students in these classes have been offered online help as part of their course enrollment. In this article, we make five assertions about teaching chemistry online during this study period. First, online assistants will initially provide answers and help but with minimal guidance will move toward providing more help and fewer direct answers. Second, less than 20% of the students enrolled in the classes are taking advantage of the help services provided. Third, no clear pattern of use based upon gender is detectable. Fourth, students can learn concepts via online instruction. Finally, the number of students in a session and the amount of time spent in a session are inversely related to the quality of the assistance provided.

The Players

At ISU typical enrollment in Chemistry 110 is 150 to 200 students. At NIU, the enrollment in the sections for which online help was available is 120 to 150. These students are typically conscientious students in that they have a desire to learn their major, but not necessarily any desire to learn chemistry. Approximately half the students have taken one course in chemistry in high school, but usually that course was as a sophomore or junior, two to four years prior to their college chemistry experience. As Bodner (2001) described as he decries the Vaccination Theory of Education, "They have had chemistry, but they no longer have it." Many of these students arrive in class with a great fear of chemistry. As one of the authors (Hunter) puts it, "They are the students who in my classes when I taught high school chemistry were absent one day a week, and when they were present, they were more likely to be thinking about the shopping mall than about atomic structure." These students are neither the most nor least able, motivated, or interested in chemistry. They are not uniform in their experience, attitude, or ability; but, they all have one thing in common, given a choice, they would rather be some place else than in chemistry class.

The Instructors

The two university instructors in charge of the respective courses, are both early in their college careers. Both are former high school chemistry teachers learning to teach in the college environment. Both have taken leadership roles in Illinois pre-service and in-service chemistry teacher education. We try to teach chemistry using constructivist methods, but often fall short of our goals. (Hunter, Carver, Short, and Young, 2001)

The Teaching Assistants

Four Teaching Assistants, all in the undergraduate Chemistry Education program at ISU worked as online teaching assistants during the year. Most provided on-line assistance for three to four hours per week. They are all sophomores and juniors who have had at least General and Organic Chemistry, Educational Psychology, but no courses in pedagogy in either the Departments of Chemistry or of Curriculum & Instruction.

The System

Consistent with constructivist thought, we attempted to use our online system to encourage students to become actively engaged with both the topic and the online Teaching Assistants. Irrespective of the mode of delivery students must have an active interaction with the instructional material (Ashmore and Taylor, 1994; Ashmore, Bouma, and Harry, 1994).

Online help was available using three forums - chat room discussions, web-based discussion boards, and whiteboard interactions. At ISU online help was available to students three evenings per week from 9:00 p.m. to 11:00 p.m. and on Friday afternoon from 1:00p.m. to 5:00 p.m.. At NIU, online help was available to students for four hours in the evening one or two nights prior to each of four exams. In addition, both instructors -- perhaps even more than other college chemistry instructors -- were available via email and telephone during the day.

For the ISU students, the interface most commonly used was WebCT (a commercial course management piece of software). In addition to online help, the complete course syllabus, many lecture and class notes, and online homework (called quizzes) were available. The interface and software are quite easy to use with a browser (either Internet Explorer or Netscape), and due to the weekly quizzing, all students could manage to access the online help. We do not believe that technical considerations were a major impediment to students from ISU.

The NIU students accessed online help via AOL Instant Messenger (which requires a minimal step up of technical competence to install on a personal computer) and WebBoard (a commercial course management piece of software). Similar to ISU, many class notes, syllabus, and interactive homework were available on-line. Although not huge, the technical barrier for NIU students was greater.

Training

With just two goals in mind, each TA experienced minimal training via an informal meeting with one author (Hunter). The main goal of the meeting was to assist the teaching assistant in understanding the lack of confidence felt by students in the course. The second goal was to encourage the TAs to provide a help service rather than an answer service. In the initial meeting, all teaching assistants agreed that "help" was a more desirable goal than "answers".  During the first two weeks of online help, one instructor helped the online TAs become comfortable with the interface and with the course goals. The TAs accepted the responsibility of providing actual on-line assistance, with little directed interaction with the instructors. The TAs, however, were encouraged to ask any questions of the instructors. The TAs took advantage of the instructors' guidance approximately once per on-line session.

Data Collection

In order to study the types of interactions and to understand what students were able to learn online, our intention was to collect the following data:

- On-line chat sessions (transcripts)
- Screen capture of all online whiteboard sessions.
- End of semester student surveys

- Student, assistant and instructor e-mail.

Technical and personal difficulties resulted in the loss of several sessions by each online TA. In particular, when conversations became too hectic for the TA (usually when three or four people were online simultaneously) records of conversations were lost.

Usage

ISU	Number of Sessions During Semester	Students Enrolled	Online Help at least once	repeat users
Fall 2000	60	200	~35	22
Spring 2001	60	150	~25	17
NIU				
Fall 2000	8	120	~20	?
Spring 2001	8	120	~20	?

Data Analysis

Data analysis for this study used an inductive methodology[4] (Goetz and LeCompte, 1984). A descriptive the meaning of that section was assigned. Each section of transcript was assigned a code. For instance,

Student A> What do I do?

Online TA> first start with the 30g and convert it to moles sucrose

was assigned the code **direct TA answer** because the student asked a question and the teaching assistant answered it directly.  In another example, later on in the same conversation,

Student B> the question just confuses me

Online TA> OK, Can you tell me what are the three things that I try always to do as I start answering one of these questions?

was assigned the code **TA probing** because the teaching assistant asked the student a question to help clarify the problem the student was having.

Once all the transcripts had been assigned codes, the authors met to determine which codes were most significant. This negotiation entailed discussing whether or not two similar codes really meant the same thing (Lincoln and Guba, 1985). For instance, the following passage:

Student C> Will you please help?, I don't have time, tell me

was coded as **student pleading,** which is qualitatively different than Student A in the first passage above who asks, "What do I do?" Hence the two passages demonstrate two different types of online interactions.

After the entire set of transcripts were coded, these codes were examined for four main themes; topic, gender, type of help, and nature of interaction.

Results and Assertions

Assertion 1 Online Instructors will initially provide answers, and help; but with minimal guidance move towards providing more help and fewer answers.

In general, we had evidence of several types of interaction between online TAs and students. For instance, at the inception of the online help service, the TAs would provide a direct answer for questions. However, later in the course of the semester, students would occasionally be told to "check a particular page in the text or to reference a particular website in response to a question. Since the TA did not give a direct answer but provided the student with the resources in order to do so, the TA was providing Help and not Answers. As the semesters progressed, more of the latter responses were provided.

In the transcript that follows, notice how the online TA provides a direct answers on three successive interactions. First, the TA describes the carbon, hydrogen, oxygen order, then the hydrogen proportions, and finally the empirical formula calculation.

Lisa>>on question #13 how are you supposed to know in which order

the elements go like COH_3, H_3CO etc.....?

Online TA>>for organic compounds like that, the order is usually carbon, hydrogen then oxygen

Lisa>>ok thanks am i on the right track? did i set up my proportions right?

Online TA >>what were your proportions?

Lisa>>i got 3.225 for C, 9.7 for H, and then 3.225 for O, then i divided 9.7 by 3.225 and got 3, so H has a subscript of #. Right?

Lisa>>sorry 3 not #

Online TA >>yes, your proportions are correct and H has a 3

Lisa>>but CH3O does not add up to 62g C2H6O3....?

Online TA >>you take the weight of CH3O and divide 62 by it then multiply all the numbers by that answer

Lisa>>ok

In each case, the Online TA, provided and answer or the next step for the students. As interactions continued, however, the TAs became more adept at encouraging and helping students. In the next transcript, the Online TA manages to provide help and encouragement, but the student comes up with the answer to the following quiz question:

Q14: Acid rain is the rainfall that contains sulfuric acid originating from organic fuels that contain sulfur. The first step of the reaction is the combustion of sulfur. Which of the following represents the starting materials for the first step?

A: 1. *sulfur* + *oxygen*

2. $H_2SO_4 + O_2$

3. $C_3H_8 + O_2$

4. sulfur + sulfuric acid

Anne>>ok...on # 14 on the quiz..

Anne >>I think that it's #3, because in the question it says something about organic chemistry and

that's the only one that fits that description...

Anne >>but there's no sulfur, so I wasn't sure

Online TA >>ok, good

Online TA >>you recognized that there was no sulfur in number three

Anne >>so then I think it is 1

Online TA >>why's that?

Anne >>because it originates from sulfur and it reacts with Oxygen...

Online TA >>right, good job

Online Teaching Assistants improved throughout the semesters as they provided more help and less direct answers to students.

Assertion 2 Less than 20 % of the students enrolled in the classes are taking advantage of the help services provided.

In total over the year there were 350 students enrolled at ISU and 240 enrolled at NIU. The total number of people who participated in online help sessions was approximately 100. This number is approximate because some help sessions were lost.[illegible] In looking back over our appointment books and class rosters from this year and previous years, we discovered, however, this 20% is still more than the number of students that take advantage of the face-to-face office based help. Given the number of students that are failing or near failing in this course, this assertion is astounding. It would tend to follow that if a student does not perform well in a course, s/he would seek assistance of some form or another. Yet, until the implementation of the Online Help Sessions, many of these students were not getting the help they needed.

Assertion 3 No clear pattern of use based upon gender was detected

Previous studies of gender and computer use have produced mixed results which suggest that there may be significant gender differences (Martin, 1991; Nye, 1991, Levin and Gordon, 1989), or in fact that no differences exist at all (Wilburg, 1995; Scott and Rockwell, 1997). Kimbrough (1999), in one of the few studies in which chemistry was taught at a distance, noted approximately 30% more female students than male students participated in online "Chat Room" tutorials with an overall participation rate ranging from 36% to 80%. During the first semester, at ISU our overall participation rate was approximately 20% but female students made up more than 90% of those who participated. Of the 35 people who used the online TA help service 30 were female and only 5 were male.[illegible] Like Kimbrough, we thought we might have tapped into a forum which would tremendously enhance female students access to instructors and learning of chemistry. Our excitement was tempered, however, in the second semester, as both males and females used the service similarly. Nonetheless, even with comparable usage between female and male students, we were pleased that female students were not disadvantaged.

Assertion 4 Students can learn chemistry concepts.

In almost every transcript, there is evidence that a student has learned at least one concept.[illegible]

Students will often respond by saying, "Shouldn't this be more difficult?" or "Now I get it, Thanks." The extent to which the students make these now seemingly self-evident comments demonstrate that the student has taken a more confident cognitive role in the concept being discussed.

In the first excerpt, show above, the TA helps Anne work through the relationship between the product and reactant in a reaction. Likewise, in the passage that follows, Julie is struggling to solve a mass-to-mass stoichiometry problem. She and the TA work through some calculations, and then in the middle, Julie recognizes that she hasn't been using the atomic masses that the TA uses. By the end of the discussion, Julie incorporated the atomic mass into the final step of the problem.

Online TA>>what did you do after you got grams?

Julie>>182mg Ca * 1g Ca / 1000mg Ca * 1 mole Ca

(CH3COO)2 / 1 mole Ca * 212.6g Ca (CH3COO)2/

I mol Ca (CH3Coo)2 = 0.965g Ca (CH3COO)2

Online TA>>After the g/mg you have to convert to mol of Ca

Julie>>I did that ....didn't I in the first few steps

Online TA>>you found the g of Ca

Online TA>>now you need to go to moles of Ca

Julie>>did that

Online TA>>182mgCa*1gCa/1000mgCa*1mol Ca/40gCa

Julie>>did that....I think I left that out up on top....but I did do that

Julie>>then I went to moles over moles

Online TA >>I think that your grams are wrong for Ca(C2H3O2)2

Julie>>I got 212.6g, Is that wrong ?

Online TA >>show me how you got that

Julie>>okay.....I think I did that wrong

Online TA >>It should be (2Ca+3H+20)*2+Ca

Julie>>okay hold on

Julie>>270.448g

Online TA >>no

Online TA >>show me what you are adding

Julie>>errrrrrrr

Julie>>I keep getting that

Julie>>I don't 2.0pt;font-family:Arial'>Online TA >>That is the amount of grams

Online TA >>do you understand that?

Julie>>is the answer to the prob. 0.536g Ca(CH3COO)2?

Julie>>that's what I got before

Online TA >>no

Julie>>now I have an idea what I did wrong

Online TA >>in your original equation that you wrote before all you have

to change is the grams

Julie>>from 212.6 to 158

Julie>>=0.717g

Online TA>>yes

Julie>>awwwww that's great.

Julie>>finally

Julie>>thank you

Julie>>:)

Julie learned the role of atomic mass in solving the mass-to-mass stoichiometry problems and was able to make the change in the problem ("*Julie>>from 212.6 to 158*") by herself to get the correct answer ("*Julie>>=0.717g*"). She also concludes with her gratitude for the time the TA has spent online with her. On this occasion, Julie's help session lasted nearly an hour. Rarely did sessions end quickly, however, the students left the sessions frequently having learned the concept they needed in order to continue.

Assertion 5 There is a limit to the number of students that receive assistance at one time.

As the number of students in a help session increase, the quality of assistance decreases. There was a limit of approximately four students per help session in order for quality assistance to take place. Management of more than four students in a help session at one time is overwhelming. Too many students are asking too many different questions at one time for meaningful learning to take place. Responses to questions tend to be more direct answers when there are more than five students in a session. In order to promote a helping environment, the amount of time spent for each student is high. The average amount of time spent on-line for each student was about 1.5 hours per session in tica, sans-serif" size="3" color="#0080FF">������������ don't know how to finish off the problem

Sandra >>does 22.5 moles sound right for #9

Laura>>not yet but I know how.

Online TA >>tira: you should have the n, R and t on top, they are all multiplied together and the atm on

Tira >>ok

Online TA >>gina: are you still on 10?

Laura >>#9, does the hot air produce enough force to lift the balloon?

Online TA >>sandra: why are you going to mols on 9?

Online TA >>laura: the hot air may produce some lift, but it is not enough

Laura>>hot air rises so it makes since to me at least

Sandra>>what do I got o I got 84 L of nitrogen gas

in my stoichemetric formula thing?

Laura>>sorry i meant #7

Gina>>yes i am on 10

Online TA >>gina: the volume should be your final answer

Tira >>i still can't figure out #9

Sandra >>does anyone know for both of the graph

questions the answer is the same on both

 right, the one that increases??

Tira>>the answers are the same

***Online TA* >>sandra: you got 84 L of N2?**

Sandra>>cool thanks

Gina>>for 10, how do i know if i have pressure in the problem?

Sandra >>yes

Online TA >>tira: you need to write out a balanced equation then convert to L of N2

Tira >>i have the equation, i just don't know how to convert it

Online TA >>gina: when it says stp you know you are at 1 atm

Online TA >>#9: the conversion between mols and L of a gas is 22.4 L/mol

Gina>>i keep getting an answer of V=44....i have 1V=1(.08206)(273) what am i doing wrong?

Laura>>does anyone no the answer to #7

Laura>>????????

Gina>>its 5

Online TA >>gina: your value for mols is wrong

Sandra>>for # 9 is the answer 3lN2

Sandra>>3 L N2

Laura >>ok thank you gina

***Online TA* >>sandra: close, but no**

Tira >>is it 44.8?

Gina> >>okay....i got mols of NH3=to 2 when i balanced it so thats what i put in the problem

Sandra >>is it 6 L N2

Gina>>i thought thats all i needed for moles

Gina>>your welcome laura

Near the end of this passage, Gina has worked out the number of moles *"i got mols of NH3=to 2 when i balanced it so thats what i put in the problem"* she needs with assistance from others, but Laura, Tira, and Sandra have been told answers

"Laura>>does anyone no the answer to #7

Laura>>????????

Gina>>its 5 >

Laura >>ok thank you gina"

with little to suggest they have learned any new ideas.> In this example and others we've seen that when the number of students interacting online goes up, the quality of assistance decreases.

Conclusion

We are pleased with the ability of our Online TAs to help both female and male students learn. The Teaching Assistants have tried valiantly not to give answers, but to provide help. Although we are frustrated with the number of students who take advantage of the online help, the number of students who return to the online help is greater than the number who visit our face-to-face office hours.>>> Finally, we would like to find a way to encourage students to interact in as helpful manner as possible even when the number of students in an online session gets larger.

Where does this study fit into the larger picture?

Our concern with many online offerings is that the intent is to teach as many people as a possible with very little cost associated.> The potential economies of scale for online teaching are very attractive to institutions and governments all over the world.> In this paper we have described an attempt to teach online in an inefficient manner.> We are attempting to put the people and the personality back into the online teaching of chemistry. In the future we will still offer online help, we'll try to be available to our students at times they need.

Diperna and Volpe (2000) recently conducted a review of 250 articles related to online learning and determined that only twelve were based upon evaluation of learning. Whether or not you believe this study fits in better with the 12 or the 238 depends upon what you believe about worth and effectiveness.> Is a service that reaches less than 20% of the students in a course worthwhile? Is a service that can teach some chemistry concepts to a few students worthwhile? Is a service that reaches females as well as males worthwhile?> For us, the accessibility with which our students are able to get help at times useful to them, yet in a personal fashion is very compelling.> You may feel differently.

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Questions for Participants

What are your experiences with online help sessions for students?

What suggestions do you have for how we can reach a greater proportion of our students?

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