Develop new learning materials and strategies for improving CHEM 1151 course

This is a continuation of the proposal made in Fall 2013 that addresses the following areas of concern in CHEM 1151, Survey of Chemistry I:

1. A need for a proper strategic plan to teach non-science major students
2. A need for instructional materials supporting cooperative learning settings for both traditional and non-traditional students
3. A need for course materials that will encourage active student engagement

In the CHEM 1151 course, we approach basic concepts of chemistry with a focus on the application of chemical theory to health science. Due to an increase in student interest in building careers in health science, Survey of Chemistry I, CHEM 1151, has the highest enrollment among all chemistry courses at Georgia Perimeter College. The course is a prerequisite for first semester Anatomy & Physiology, BIOL 1611, which is the first stepping stone towards any professional degree in health science. Upon successful completion of this course, students are expected to have a firm understanding of the chemical behavior of biological substances and the direct applications of chemistry in various fields of medicinal, forensic and pharmaceutical industries. At GPC, this course has been offered in different formats including traditional, hybrid, and online. The average passing rate for this course was 62.4% in the academic year 2013 (ABC grades), thus not reaching the lower quartile of the total student population. The failure rate is also not negligible with an average of 14%. These results indicate a need for improvement on the learning materials and strategies for CHEM 1151 course.

Background Information and Literature Review: Most colleges and universities offer online courses (Martin, 2012; Norma I. Scagnoli, Vol 13(2)) and thus, help distant learning students to complete their course requirements online. Though online courses are in abundance now (Allen, 2011), few online chemistry courses that are offered have little to no literature measuring their efficacy. Some work has been done to study the effect of offering non-chemistry courses online or in a hybrid format instead of the traditional face-to-face format (Pratt, 2010). Web based tutorial materials like teaching videos or molecular simulation to teach basic chemistry as well as higher level chemistry courses are growing day by day. Chemistry educators are using these online resources to teach their F2F courses. Current research describes the benefits of active learning approaches like iclickers or student response system technology in promoting active learning in Chemistry courses (Martyn, 2007) (Caldwell, 2007). Most research on the benefits of using iclickers in the classroom has shown that students become engaged and enjoy using them. We have been considering this application of technology in classroom for some time; and in this study, we will attempt to determine the difference in effectiveness between online and face-to-face presentations with or without technology enhanced teaching methods for the first semester survey chemistry I course at GPC.
Objective: In this study we will examine if there is a relationship between the nature of the course delivery and students’ achievement. We will look at the students’ performance based on the different assessment tools created in technology-based classes and compare with traditional format classrooms where the usage of technology is minimized by oral instruction and whiteboard presentation. We will evaluate the online homework program and its effectiveness as a learning tool in all different formats of this course. We will attempt to understand the difference in effectiveness between the technologies or web enhanced teaching methods with traditional content delivery system by comparing overall final grade distributions for all the formats.

Findings from Previous Study: This project started in Fall 2013 and has been conducted by PI Dr. Dutta and co. PIs Dr. Burkart and Dr. Blum. According to the data analyzed for two semesters of Fall 2013 and Spring 2014, no significant differences were seen between online and F2F courses when comparing the exam questions covered in the exams at the “analyze” level. Online instruction appears to be as effective as F2F instruction when teaching CHEM 1151 introductory chemistry topics except the comprehensive final exam where face-to-face course students performed better compared to distance learning course students. One probable reason for the lack of adequate performance of online chemistry course students in final exam is that the final exam is moderated in a face-to-face environment instead of on a personal computer without moderation. Online students are not accustomed to take a test which is in paper form and includes the entire course materials. As online courses studied here are self-guided, students may have spent more time focusing on grasping the materials than on the application of the knowledge. Similar observations were made by other researchers on this subject (Ozcan Gulacar, 2013). Among the different format of face-to-face courses, traditionally taught course has been showing steady performance in terms of overall grade distribution, technology enhanced courses have been showing uneven trends in final exam to unit test performances although overall grade distribution is same as traditionally taught. At this point, more data is required to reach to any particular conclusion in seeing the difference between technology-enhanced courses and traditionally taught course.

Activity Plan: Classroom students are the main participants in this research study. Researchers may not exclude student participants on the basis of gender, race, national origin, religion or socioeconomic status. An announcement will be made in class to inform the students about the study; extra points will also be offered to encourage the students to participate in the project. Any information about individual students’ grades or names will not be disclosed in connection with this research by PI or any of the co-PIs. Assessment instruments that are created by the investigators for the research study will be applied to all the sections. These assessments will be submitted at the conclusion of the project. Total five faculty members will participate in this continued study. One of the instructors, Dr. Burkart will teach using traditional method such as oral delivery of the materials and instructions, Dr. Blum’s course will use demo videos in explaining the concept. Dr. Atteya will use flipped class model to teach the course and Dr. Dutta will be using iclickers for her class and lastly, Dr. Gonzalez’s class will be a distance learning course and all the course content materials
for this class will be delivered through web based technology. There are total five online quizzes, four unit tests, ten online homework assignments, and one final exam which are planned for all five sections to evaluate students’ performance throughout the semester. Students’ performance will be evaluated only for selective questions from each test which are based on the core concepts that are covered in the course content. Average grades will be compared for quizzes and homework assignments. Different parameters generated by the assessment evaluation program ParScore™ will be studied for each unit test to understand the effect of technology in teaching this course as well as face-to-face vs. distance learning format of the same course. Tests and quizzes will be given at the same period of time in all the sections to maintain the uniformity of the assessment period. All five courses will have same text book and grade distribution policy based on the assessment methods used. In addition to the standard assessments tools, an online survey will be conducted at the end of each semester to gather students’ opinion about the learning outcome from different methods of teaching. All data will be analyzed and conclusion will be drawn from the data analysis.

**Evaluation plan:** Gradebook data will be used to evaluate student performance in different fields. Data will be collected for classes taught during the present academic year as well as for past years, and a comparison study will be developed to find the best format and strategic plan to teach this course. In the future, statistical analyses such as ANOVA (analysis of variance) will be performed to incorporate Bloom’s Taxonomy classification (analyze, evaluate and create). Also for extended analysis, comparison study will be performed to find the effectiveness of lab instructions on lecture course performance. Additionally summer semester (7 weeks long) performance can be compared with full semester performance (14 weeks long). For this study, all the exam questions chosen are multiple choice type and as a consequence no comparison at higher order of thinking that requires short answer type questions, student-drawn chemical structures etc. are made from this study. The following information will be extracted from the students’ grades:

1. Average grade, standard deviation on selective questions for unit tests and online quizzes for face-to-face, technology enhanced and online courses.
2. Average grade of online homework and online quizzes.
3. Students’ own opinion about learning experience in online and face-to-face classes.

**Dissemination Plan:** The findings of this study will be presented at professional meetings and faculty development workshops. PI and co-PIs will be responsible for publishing the results. The results will be implemented in classroom teaching. Also, research findings will be shared among peer faculty members to implement new strategies for teaching the course. The quality of the published work will be the indicator of the impact of this research project.

**Personnel:**

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References:

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- **Greg Pratt**, “Hybrid Course Delivery in Microeconomics: A preliminary report based upon: Current research, practice and hybrid courses taught in ECN 112 Principles of Microeconomics” at Mesa Community College