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Of Special Interest

Report On "Planning And Implementing Curriculum Change in Chemistry: A Case Study in Creating a Blended General/ Organic Course Sequence"

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The students will be exposed to more active-and cooperative-learning techniques as well as introduced to the guided-inquiry method in the new curriculum.

A new curriculum involving a blended general and organic chemistry course is being introduced at San Jose State University this fall by Stephen Branz and Maureen Scharberg. They shared their experiences in creating this new curriculum and described how they overcame resistance to this change from the university community to the workshop participants. The participants of the workshop then had the opportunity to examine the new curriculum and consider how they would approach problems in both the planning and implementation phase of such a project. The workshop participants created a final list of "pros and

"Planning And Implementing Curriculum Change in Chemistry: A Case Study in Creating a Blended General/Organic Course Sequence" by Stephen Branz and Maureen Scharberg was presented at the "Day 2 to 40" workshop symposium held May 10–11, 1997. The two-day event was held in the Willard H. Dow Chemical Sciences laboratory building on the central campus of The University of Michigan in Ann Arbor, Michigan. Each of the articles that comprise this issue was written by one of the group of reporters whom I asked to attend each session to take field notes and then follow up with the session leader and participants afterwards.

—Brian P. Coppola, Proceedings Editor

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cons" for the planning stage (content, pedagogy, and transportability) and a list of possible strategies for the implementation stage (marketing, resources, and logistics).

Descriptive Outline (Chronology)

1. The blended organic and general chemistry course at San Jose State University was described.

2. The workshop was divided into groups of three people each to discuss how to plan a curriculum change similar to the changes in the introduction. Each group was responsible for one area of planning (content, pedagogy, or transportability). Each group member recorded the group's consensus for future use.

3. The groups were scrambled into different subgroups of three people (a jigsaw) and each reported the consensus of the groups they were originally part of. There was time for discussions and questions within the subgroups.

4. The original groups were reconstructed and each member relayed what had been learned in the "jigsaw." A final group report was prepared to be reported to the entire workshop.

5. After a break, groups of three were formed to discuss the actual implementation of the curriculum change.

6. The groups again did a "jigsaw" to share decisions.

7. The individual groups reported to the workshop to form the final product of the workshop, a list of "pros and cons" of this curriculum reform with respect to planning (content, pedagogy, transportability) and a list of strategies for the implementation (marketing strategies, resources, and logistics) of this proposal.

Main Report

Introduction

The introductory chemistry program at San Jose State currently consists of a traditional two-year sequence consisting of two semesters of general chemistry followed by two semesters of organic chemistry. The authors of this workshop, Stephen Branz and

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Maureen Scharberg, have proposed a curriculum replacement of this sequence with a four-semester sequence involving integrated general and organic chemistry courses.

The reasons for the proposed change include involving the 300–400 students per year with more real-world experiences and applications. The students will be exposed to more active-and cooperative-learning techniques as well as introduced to the guided-inquiry method in the new curriculum. There will also be more instrumentation involved earlier in the first year, including IR and GC with hands-on opportunities for the students. Because most students traveling through the chemistry program are biology majors (with a scattering of biochemistry, chemistry, environmental science, chemical engineering, and geology majors) the curriculum change, summarized as introducing a more holistic approach to chemistry, is expected to serve the students better than the more traditional approach. One of the key features of the new curriculum is the addition of a spiraling approach to learning, where concepts are revisited at least once each semester. This is proposed to facilitate the movement from qualitative to quantitative concepts within the course sequence.

This proposed change complements the national trends in the integration of undergraduate chemistry education. The San Jose team is cooperating with the University of Wisconsin's "New Traditions" project. This project also fits well with national reform trends as exemplified by the American Chemical Society's new textbook: *Chemistry in a Biological Context*.

The assessment of how well this reform benefits student learning will be conducted through outside agencies. The assessment of student attitude and acceptance will be done by the University of Wisconsin's LEAD (Learning through Evaluation, Adaptation, and Dissemination) Center. The evaluation of how well the students learn the chemical content of the sequence will be determined by the American Chemical Society's Examinations institute.

Details of the Blended General and Organic Curriculum Change

A packet containing the details of the proposed general and organic chemistry curriculum change was distributed to the workshop participants. The catalogue descriptions for this sequence, which is proposed to begin Spring 1998, are:

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CHEM 5A: General and Organic Chemistry
Basic principles, concepts, and methods of chemistry. Emphasis on the structure, properties, and reactivity of main-group elements, hydrocarbons, and oxygenated carbon compounds. The laboratory introduces techniques for the preparation, isolation, purification, characterization, and identification of pure substances in a discovery-based context.

CHEM 5B: General and Organic Chemistry
Continuation of 5A. Emphasis on the structure, properties, and reactivity of transition elements, unsaturated hydrocarbons, organic halides, alcohols, ethers, and amines. The laboratory continues examination of techniques introduced in Chem 5A with a greater emphasis on theory as it relates to the design and modification of methods and procedures.

CHEM 115A: General and Organic Chemistry
Continuation of 5B with a quantitative treatment of thermodynamics and kinetics. Emphasis on the structure, properties, reactivity, and synthesis of organic compounds, especially aromatic and carbonyl compounds.

CHEM 115B. General and Organic Chemistry
Continuation of 115A. Emphasis on the chemistry of biological systems and of materials.

The workshop provided a format for the discussion of the advantages and disadvantages of this approach, and the final result of the workshop was a generated list of “pros and cons” and strategies for blending general and organic chemistry.

Instructions for the Groups
One colored card (red, white, or blue) containing a letter (T, G, or R) was distributed randomly to each workshop participant. Groups of three were formed by people having the same color, but different letters. The letters indicate the role within the group (T indicates the timekeeper; G indicates the gatekeeper, who makes sure “pros and cons” are discussed, and R indicates the recorder). The color of the card determines the focus of the group (red focuses on content, white on pedagogy, and blue on transportability).

After discussion within their group ends, each member moves to a new subgroup with people holding different-colored cards. This rearrangement (known as a “jigsaw”)

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allows the collaboration of different groups that are knowledgeable in different areas. After the jigsaw the original groups were reconstituted and new discussions within the group were conducted and reported.

A similar strategy was used to consider questions involving implementation of the proposed curriculum change. The meaning of the colors was changed (red focused on marketing strategies, white on resources, and blue on logistics). The discussion, group "jigsaw", and reconstitution of groups, was to be used again.

At the end of the workshop a final list of "pros and cons" or strategies for each of the areas discussed was prepared from the discussions.

Dialog

Dialog Between Workshop Participants and Leaders

There were many questions from the participants regarding the proposal. One question was how the change would affect chemistry majors, because one of the stated goals was to make chemistry more accessible for nonchemistry majors. The leaders responded that the chemistry content of the upper level classes will be unchanged, so the overall education of chemistry majors should not be adversely affected.

A common question throughout the parts of the workshop that were open to questions was how the lack of a textbook containing this material would affect this curriculum change. The leaders pointed out that they are drawing on a variety of books, but they acknowledge that this is a drawback for widespread implementation of this curriculum.

One participant wanted to know if this large reform effort would be possible without financial support for the innovators. They replied that teaching loads are heavy enough and that any effort of this sort would be very difficult unless extra time was provided.

The question of how to handle transfer students, students changing majors, or failing students is to be handled by demanding that students who start in this new sequence finish in this new sequence. Everyone seemed to realize that segregating students in this new curriculum could have negative consequences for some students under these special circumstances.

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Dialog between Workshop Participants

The main product of this workshop was a participant-generated list of "pros and cons" or brainstorming strategies for the proposal to blend general and organic chemistry. The list is given below.

Pros and Cons

- Content

  Concepts are introduced sooner
  May sacrifice depth for breadth
  Learn experimental skills earlier
  Possible shallowness
  How to calibrate spiraling
  Force faculty to talk

- Pedagogy

  Students think critically
  Faculty resistance
  See continuum of chemistry
  Faculty loss of control
  Inquiry laboratories
  Personal responsibility
  Coop learning (for students)
  Logistics of coordinating laboratory
  Computers (lots of Computers, possible information overload)

- Transportability

  Growing biochemistry and biotechnology programs
  Must have multitracks
  Requirement for instrumentation
  Customizable
  No textbook
  Small classes OK
  Changes hard at large schools
  Handling transfers
  Faculty "turf" problems

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Marketing Strategies

- Get someone to be a catalyst and perhaps someone else to push, or write or test, etc.
- Identify a major group taking the class (example biology) and gather support from outside the department.
- Try to show a better retention of material.
- Provide more release time for faculty.
- Convince others in the department you aren't losing efficiency.

Resources

- See what instrumentation you already have, and use it.
- Try to obtain release time/split loads if possible.
- Obtain support for faculty development.
- Obtain space from the department.

Logistics

- Arrange for classroom time and space.
- Meet requirements for the transcript record.
- Retrofit laboratories for safety.
- Train staff.

Adoptive Participation

Because this is an experimental project being developed at SJSU it is not surprising that there was little discussion involving the strict adoption of this program. Although "transportability" was an explicit discussion topic, the workshop participants wanted to see the program "work" before they would use it without any adaptations.

Adaptive Participation

The general mood of the participants was that this was an interesting change, and there might be something applicable to take to their home institutions. Before trying to change anything "at home," however, people were interested in seeing how the changes turned out at SJSU. This amounted to a "wait-and-see" attitude for the next two years while the change is implemented, and any decisions will be made after evaluations are made.

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Feedback

One feature of this workshop that was heavily commented on was the high level of organization. Some of the respondents enjoyed the organization, saying it was “great” and “better than I expected”, while others felt it was “ too structured” with not enough time for “flexible discussion periods.” The majority of participants would have liked more time to discuss the nitty-gritty of the proposal with the leaders with the understanding that the time could be removed from the small-group discussions without detriment to the workshop experience.

Several respondents thought that more time should be spent discussing the philosophy of the reform. If the current model is inadequate, why choose this model of reform over others? What process do you use to decide between models? What are other views among the participants? Why will the proposed changes be expected to work? What about other similar reforms that have failed? Will this change how students learn?

On a practical note, one participant wished that the instructions given for the groups had been published before the workshop so the participants could have prepared. The time to figure out the directions was too long, he said.

The one comment appearing most often from the respondents was that it was interesting how much resistance this proposal for curriculum change received at a conference dedicated to curriculum change! Some pointed out the irony of the situation; others pointed out their reason for resistance. But, the differences in opinion gave rise to spirited discussions throughout the workshop, in the feedback, and likely in the future too!

Workshop Participants

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