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## Blended Learning Pedagogy-A Need in Chemistry

Ruchi Saxena, Department of Chemistry

NSN(PG) College, Lucknow, India

### Abstract

The subject Chemistry is the constant interplay between the macroscopic and microscopic i.e. the abstract levels of thought, and it is this aspect of chemistry that makes learning a challenge to novices. Traditionally lectures, the most commonly used teaching approach for Chemistry in higher education does not allow students to develop cognitive and metacognitive thinking skills required for learning. A survey of 50 undergraduate students of Chemistry at NSN(PG)College, Lucknow, using an instrument in form of a questionnaire was conducted to understand the need of Blended learning. The result indicated that 70% students did not enjoy the chemistry lectures though they liked working in the labs and 50% do wish to study chemistry in future and almost all felt the need of Computer assisted instructions. Thus face to face teaching incorporating computer assisted instructions modules were made for teachers/instructors and the students in undergraduate classes. Working modules in Stereochemistry of Organic Compounds and Qualitative Analysis of Organic Compounds for ready implementation were also made. Once these modules are implemented they can reinforce both an interactive and communicative learning environment and provide meaningful learning outcomes.

### Introduction

One of the essential characteristics of chemistry is the constant interplay between the macroscopic and microscopic (abstract) levels of thought, and it is this aspect of chemistry that makes learning a challenge to novices (Bradley & Brand, 1985). Chemistry is thus perceived as a difficult subject and repels students from continuing with studies in chemistry. Students' disinterest in chemistry can also be correlated to poor academic achievement

(Alavi & Hoseini 2009) which is directly linked to attitude: positive or negative feelings,

(Can 2012) and lesser career options in India (Garg & Gupta 2003). Traditionally lectures are the most commonly used teaching approach for Chemistry in higher education. Focusing only on face-to-face interaction does not provide space for collaborative learning, nor does it allow students to develop cognitive and metacognitive thinking skills. Most university students feel that whatever is taught in class is boring and detached from career requirements and do not perceive the classroom climate as motivating or supportive. At the same time, the increasing presence of technology example, computers, smart phones and tablets, has changed the students' behaviour and attitude, and has altered the manner in which they learn and communicate in and out of class. To obtain a positive attitude towards chemistry with enhanced metacognitive skills, chemistry learning systems need to be innovated. Hence a restructuring is required in the teaching-learning process and digital technology is regarded as an effective tool. Integrating technology with face-to-face instruction can reinforce both an interactive and communicative learning environment and provide meaningful learning outcomes. One of the learning model innovations carried out by utilizing computer assisted instructions (CAI) is known as blended learning. It was defined for the first time by Dr. Margaret Driscoll as "to combine or mix modes of Web-based technology (e.g., live virtual classroom, self-paced instruction, collaborative learning, streaming video, audio, and text) to accomplish an educational goal." (Driscoll 2002). Graham defines blended learning as follows: "Blended learning systems combine face-to-face instruction with computer-mediated instruction." (Graham 2006). Garrison and Kanuka define "blended learning as the thoughtful integration of classroom face-to-face learning experiences with online and computer mediated learning experiences." (Garrison & Kanuka 2004). Thus blended learning has become an umbrella term and can be a combination of online learning, face-to-face learning, and real-world experience. Conceptualizing of blended learning can be done in a broad way, and can expect that most educational institutions could conduct blended learning, or will in the near future. (Oliver & Trigwell 2005) The term "Blended Learning" has been adopted by researchers and practitioners in a similar way as computer-assisted learning or technology-enhanced learning.

With the computer assisted instructions, blended learning can be implemented anywhere, anytime and also can be collaborated with anyone. In blended learning it is the instructor's decision to select the content, depending on the learning context, and the skill to be mastered by

the student by the end of the course(Rooney 2003).Most undergraduate chemistry courses usually include lectures and tutorials in the traditional teaching mode for conceptual knowledge together with laboratory work to enhance understanding and practical skills. In this paper, a survey of 50 undergraduate students of Chemistry at NSN(PG)College, Lucknow, is done using an instrument in form of a questionnaire to understand the need of Blended learning. The paper also gives an insight into teaching and learning chemistry by providing teaching-learning modules for teachers and students with specific working modules for (1) Stereochemistry in Organic Chemistry and (2) Qualitative analysis in Organic Chemistry. These modules would enhance attitudes towards chemistry and help in developing the metacognitive skills of undergraduates and have better learning outcomes.

## Methodology

### Research Design

Literature review and a preliminary study on the need of blended learning by an instrument in form of a questionnaire was used. The validation and evaluation of the preliminary research lead to the designing of the of a teaching-learning module for teachers and students together with specific working modules for Stereochemistry of Organic Compounds and the laboratory course in Qualitative Organic Analysis.

### Sample

The sample size included 50 undergraduate students of Chemistry at Nari Shiksha Niketan (PG) College, Lucknow, at the same level of learning from similar socio-economic backgrounds, same region and having similar secondary education, exposed to the same teaching staff and facilities.

### Instrument

Data collection instrument was a questionnaire which was analysed quantitatively. The instrument was arranged based on four indicators. The first indicator showing attitude towards chemistry(Cheung 2011) the second indicator shows the Behavioural tendencies to learn chemistry; the third indicator refers to the awareness about models and Computer Assisted teaching (CAI); and the fourth indicates the need for blended learning modules(Table1).

**Table1:** Indicators of need analysis for blended learning modules

Indicator	Item	Results
Attitude towards chemistry	<p>Chemistry lectures are interesting and easy to understand.</p> <p>I like to work in the chemistry laboratory.</p> <p>When I am working in the chemistry lab, I feel I am doing something important.</p>	<p>Most students found lectures interesting but 70% of the students could not comprehend much.</p> <p>100% students like and enjoy laboratory work.</p>
Behavioural tendencies to learn chemistry	<p>Chemistry is useful for solving everyday problems.</p> <p>People must understand chemistry because it affects their lives.</p> <p>Chemistry is one of the most important subjects for people to study.</p> <p>I would like to study Chemistry in future.</p>	<p>90% of the students cannot relate to chemistry for solving everyday problems, but do understand the ill-effects.</p> <p>Everyone(100%) should study chemistry.</p> <p>50% of students do not wish to take up Chemistry for future studies.</p>
Awareness about Model and Computer Assisted teaching	Do teachers use special teaching materials like Teaching models and PPT to teach.	Only models are used with face to face teaching.
Need for blended learning modules	<p>I would need slow teaching and better explanation</p> <p>I need a chemistry learning module that I can use anywhere and anytime.</p> <p>List those topics which have been taught in face to face learning but you think computer aided instructions will give you a better understanding.</p>	<p>Students want better more detailed explanations.</p> <p>Modules with video mode and PPT will definitely provide better understanding</p> <p>Chemical bonding, Reaction Mechanism, Stereochemistry, Thermodynamics, Analytical Chemistry etc.</p>

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## Results and Discussion

The Questionnaire of the instrument (Table 1) used for survey helped to make a cognitive diagnosis though it had a relatively multilevel response in relation to the learning difficulty to be measured. The results indicated that the students did not like chemistry lectures. They enjoyed doing practical work but were very slow in interpretation. Conventional methods still dominated the learning process. Computer assisted technology was rarely used as a learning resource. The students were aware of the use of internet (for example, e-mail) as a learning resource. Face to face is not adequate as there are learning difficulties in Chemical bonding, stereo-chemistry, reaction mechanisms, synthesis strategies and thermodynamics. Almost 50% of the students do not want to study chemistry in future.

Chemistry curriculum at most universities is still mostly fact based and encyclopaedic, built upon a collection of isolated topics, oriented too much towards rote learning, focused on abstract concepts and algorithmic problem solving. Chemistry learning and skills needed for discovery and experimentation can be made easy by using real life experiences depending on the learning objectives. (Mahaffy 2004) Blending face-to-face teaching by relating it to day to day life and Computer Assisted instructions can help students to visualize and interlink the macro, semi-micro or abstract concepts with the symbols (Ghassan 2007). The blended learning module must integrate the features of (1) computer assisted instructions-Power Point Presentations (PPT), (2) mailing of notes (3) face-to-face teaching modes (4) teaching with the help of three dimensional models (5) demonstration of laboratory experiments by teachers in the laboratory (6) multimedia videos (7) assignments to be done by mail. Teacher-student interaction will increase by the use of internet and thereby make learning easy. The framework of blended learning multicomponent teaching module in chemistry is illustrated in (Figure 1) which has been implemented in the teaching of Stereochemistry of Organic Compounds (Figure 2).

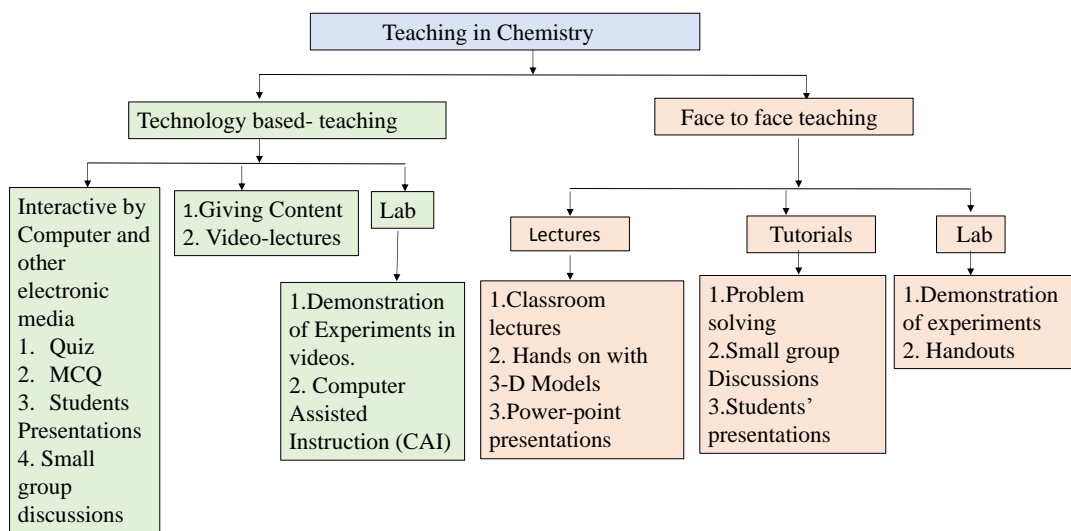


Figure1: Teaching in Blended learning

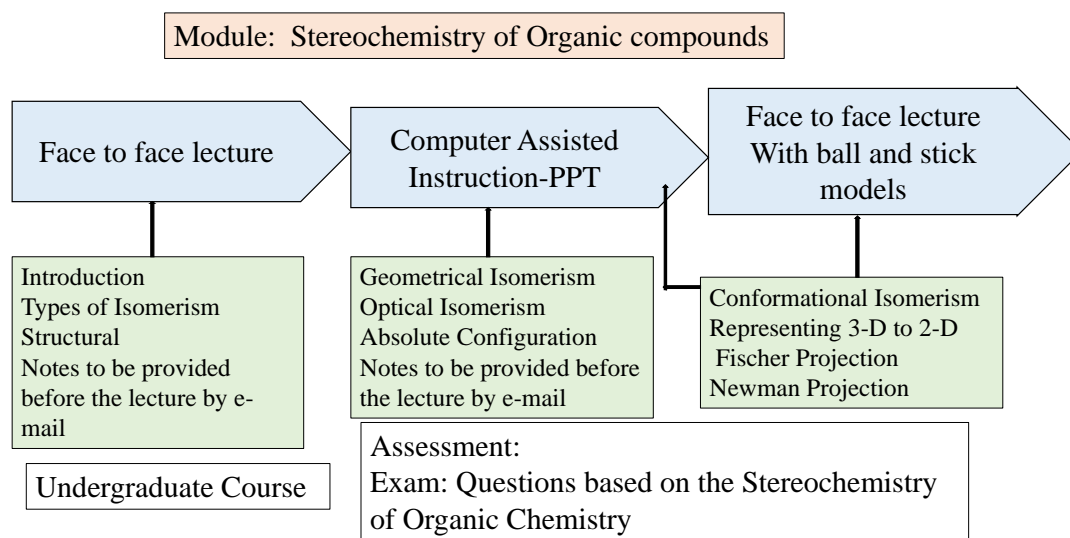


Figure 2 Module on Stereochemistry of Organic compounds

Modules given in Figure 1 and Figure 2 combine resources and pedagogy from the perspective of the teacher or the instructor to enhance the learning outcomes based on attitude-driven learning, which mixes various events and delivery media to develop specific behaviours for

learning. To develop skill-driven learning, which combines self-paced learning with the teacher or instructor, to acquire specific knowledge and skills with competency, to blend with performance support tools and knowledge management resources for workplace competencies two modules on the role of students and a the laboratory working module (Figure 3,4) are illustrated.

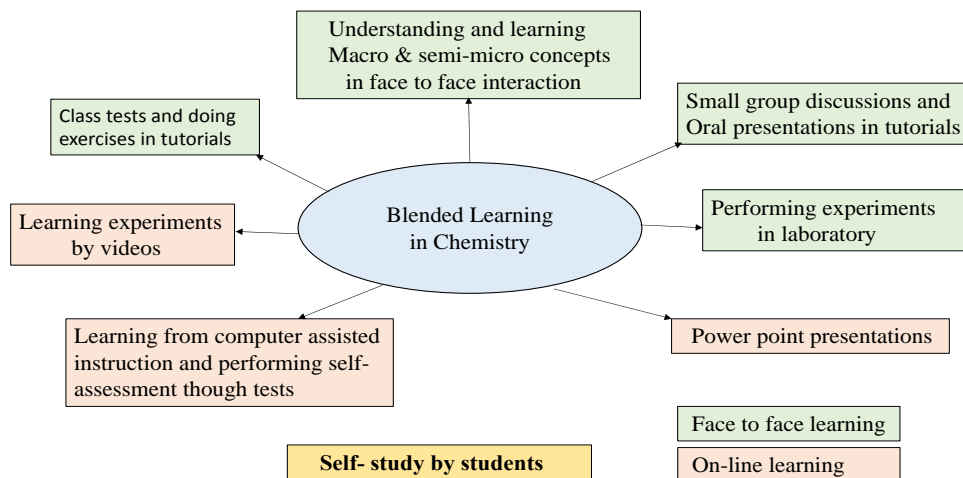


Figure 3: Role of students in blended Learning

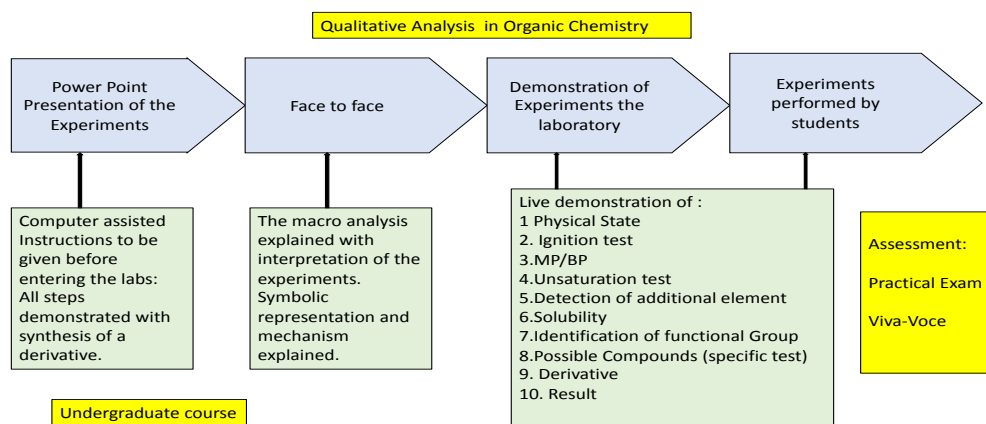


Figure 4: Module for Qualitative Organic Analysis

The undergraduate course consists of Inorganic, Physical, Organic together with laboratory work with 70% students having learning difficulties in bonding, stereo-chemistry, reaction mechanisms, synthesis strategies, thermodynamics and many more. Approximately 50% of the students do not want to study chemistry in future, but changing the curriculum may not solve the learning difficulty or change the attitude (Bodner 1992) of learners. It is envisaged that the attitude of students towards chemistry will change from negative to positive and also improve their meta-cognitive skills by implementing the above modules which help in removing the misconceptions about chemistry (Brickhouse & Bodner 1992). The approach to teaching Chemistry should change and according to Talanquer and Pollard "Let's teach how we think instead of what we know" (Talanquer & Pollard 2010) will bring a change in the learning attitude. Since the new generation is highly tech-savvy, a blended learning approach will increase the students' access to information and the interaction with the teacher or the instructor leading to a significant improvement in the attitude and learning ability.

Blended learning pedagogy may work very well in the developed countries but the frequent electricity cuts, especially in the developing countries, different socio-economic backgrounds or lack of IT knowledge (Holley & Oliver 2010) of students will be a hindrance. Lack of immediate response as compared to face-to-face classroom interaction may lose their sense of classroom community (Vonderwell 2003). Thus, it is important to learn about students' needs and preferences before planning lessons. Instructors need to be trained and/or have an IT support while troubleshooting problems.

## Conclusion

Blended learning seems to be a very interactive and exhaustive mode of learning to inculcate and reinforce core elements of Chemistry in all of the areas i.e. Physical, Inorganic and Organic. The laboratory exercises too will help in developing the fundamental laboratory skills in "real-world"-type scenarios, planning experimental work, drawing conclusions, and developing broader problem-solving skills in individual, pair-work and team-work situations.



As the blended learning module is implemented in Chemistry the lessons will become interesting thereby shunning the phobia of chemistry.

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