Organic Chemistry:
Intensive Format or Traditional Format

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Introduction

As a result of the recent movement on increasing students' performance in organic chemistry using different learning tools, Peer-Led Team Learning (PLTL) (1-6, 8), has seen the greatest impact on students' achievement in this area. I wish to put forward an argument in favor of another learning style (Intensive Format) being an alternative method of achieving better success in organic chemistry.

Peer-Led Team Learning is a workshop model where students work together in small groups of 6-8 persons, in weekly two-hour sessions. The main objective of this model is creating a community of learners who are actively engaged with the material and fellow students. The model uses facilitators who are former students who have previously taken the course and performed well in it. The workshop materials were obtained from PLTL Organic Chemistry Book Series (7) and In-house. Students in this workshop are our traditional students.

In the Summer Institute in Science and Mathematics (SISM), the traditional twenty-eight week, two semester sequence is condensed into two four week terms in the summer. Classes meet five days a week (Monday-Friday), and three hours each day. This is the intensive format. Until now, there has been only one study (9) that compares

learning of organic chemistry in semester or quarter format vs intensive format.

Sometimes, the terms intensive and accelerated are used interchangeable when it comes to course formats. I would like to make the distinction for the purpose of the study presented here. The intensive learning format is different from an accelerated learning format. The difference is that, accelerated courses are often structured in condensed formats that use weekend and evening classes, workplace programs, and distance learning. These courses are designed for students to do more work (to learn material) independently outside of class. In the intensive format, a semester course is condensed into a shorter time. Nothing is sacrificed with respect to the course material and students are not expected to do more independent learning. The objectives of the courses are the same as those of the traditional formats. In order to understand how effective intensive courses in organic chemistry are as learning format, a four year study was conducted involving two institutions, Summer Institute in Science and Mathematics (intensive format) at Capital University and a nearby anonymous university (traditional format) in central Ohio (9).

After eight years of teaching organic chemistry in both the traditional format as well as the intensive format of the Summer Institute in Science and Mathematics at Capital University, it is time for me to share what I have learned with other educators in this field. This study compares two types of learning approach: Intensive learning/study groups and Traditional learning/Peer-Led Team Learning (PLTL). A previous study comparing intensive format with traditional format without any additional aid points to the fact that organic chemistry is better learned using the intensive format. The purpose and design of the study is the same as the previous study (9).

Purpose of the Study

The purpose of this study is to examine: (1) the effectiveness of intensive course format for student learning, (2) the impact of this format on students motivation for learning, and (3) content mastery.

Design for Comparing Formats

In this study the same instructor taught organic chemistry in the traditional/PLTL format (late August-May) at one university and the intensive/study group format (June-August) at Summer Institute in Science and Mathematics (Capital University), using the same text

(11), the same syllabus (the same objectives), and the same exams. The study compares the final grades of students as well as anonymous course evaluation surveys.

Major Findings

How Effective (Content Mastery) is the Intensive Format?

The intensive format accommodates innovative teaching (pedagogy or teaching methods) and learning opportunities due to three hour a day class time. As a result of this, students have more time to interact with peers and work effectively together and with the instructor. In the traditional format, the instructor has only fifty minutes to lecture and interact with students three to four times a week. This sometimes leaves the instructor with little or no time for innovative teaching or time for students to work effectively together in class. The data below addresses a frequently asked question—whether students in the intensive courses learn the material as well as students in the traditional courses as measured by course grades.

The study focuses on course grades and nationally normalized and standardized American Chemical Society organic chemistry exam (ACS Exam) (10). This is due to the fact that colleges, universities, and professional schools use grades as one of the major components for admission and evaluation of student performance in the course. Some faculty argues that grades are not the best measure of learning but, they still use it in their courses to measure student learning outcome.

The content mastery of students was measured based on their total quiz and exam points. There is a difference between the two formats in the grading scale. In the Intensive format, the passing grade in the course was 70% or higher while in the Traditional format the passing grade was 60% or higher. This study looks at the percentage of students with grades of seventy percent (70%) and above each year during the four year period of the study. The results for the Intensive format are: year one—89.7% of the students passed in the first session and 92 % in the second session; year two—88% in the first session and 94.4% in the second session; year three—80% of the students passed in the first session and 72% in the second session; year four—77.3% in the first session and 93.3% in the second session. For the Traditional format, 54.4% of the students passed in the first semester and 80% in the second semester for the first year. In the second year, it was 45.2% in the first semester and 40 % in the second semester. In the third year, it was 45.5% in the first semester and 36.7% in the second semester. In the fourth year, it

was 33.3% in the first semester and 62.5% in the second semester (see Table 1). These results provide some evidence that the intensive format is an effective method for learning (and time has little or no effect on academic achievement).

Table 1. Learning Outcome (Grades) by Type of Format

	SISM 2003 (intensive course)		Anonymous university 2003/2004 (traditional course)	
	1st Session	2nd Session	1st Semester	2nd Semester
Total # of students enrolled	29	25	31	21
Grading scale (%)				
A > 90	4	5	A > 85 7	6
B > 80	15	9	B > 72 10	11
C > 70	7	9	C > 60 10	3
D > 60	3	2	D > 50 0	1
F > 50	0	0	F > 40 4	0
% of students with 70% and above	89.7	92	54.8	80

	SISM 2004 (intensive course)		Anonymous university 2004/2005 (traditional course)	
	1st Session	2nd Session	1st Semester	2nd Semester
Total # of students enrolled	25	18	31	25
Grading scale (%)				
A > 90	8	6	A > 85 4	4
B > 80	5	8	B > 72 10	6
C > 70	9	3	C > 60 14	13
D > 60	3	1	D > 50 0	2
F > 50	0	0	F > 40 3	0
% of students with 70% and above	88	94.4	45.2	40

	SISM 2005 (intensive course)		Anonymous university 2005/2006 (traditional course)	
	1st Session	2nd Session	1st Semester	2nd Semester
Total # of students enrolled	25	25	33	30
Grading scale (%)				
A > 90	4	5	A > 85 4	2
B > 80	4	4	B > 72 11	9
C > 70	12	9	C > 60 16	12
D > 60	5	7	D > 50 1	5
F > 50	0	0	F > 40 1	2
% of students with 70% and above	80	72	45.5	36.7

Table 1. Learning Outcome (Grades) by Type of Format (continued)

	SISM 2003 (intensive course)		Anonymous university 2003/2004 (traditional course)	
	1st Session	2nd Session	1st Semester	2nd Semester
Total # of students enrolled	22	15	24	16
Grading scale (%)				
A > 90	3	4	A > 85 1	2
B > 80	6	8	B > 72 7	8
C > 70	8	2	C > 60 11	3
D > 60	5	1	D > 50 2	3
F > 50	0	0	F > 40 3	0
% of students with 70% and above	77.3	93.3	33.3	62.5

How Motivated Are the Students?

The intensive learning format is not for everyone, and as such, only those talented and very motivated students usually enroll in these courses and organic chemistry in particular. There is no doubt that students in the intensive courses have a stronger motivation for success than their counterparts in the traditional courses. Summer Institute students appreciate how the course has been taught and they often make comments like "The instructors are pushing us beyond what limits we thought we had." More than ninety percent of the students talked about the course having been "too demanding, yet interesting and fun." Also, that they have never experienced such a "wonderful" learning environment.

Intensive format students' perception towards organic chemistry after the third week of classes is more positive than those of the traditional format and this might also improve student learning.

At the end of the program students also comment on their perception of the course:

> • My perception on this course is that it is very challenging. The course requires much time and the ideas are very complex. But I do feel that with any other teacher, the class would have been unbearable. You made class fun and enjoyable, which made the class not as difficult to sit through. Also you explained the topics very well. But overall, besides from the class being very challenging, the time was enjoyable.

From another student:

> • My perception of organic chemistry has somewhat changed. This class has proved to be the most challenging class I have ever had.

> However, it wasn't impossible. In order to succeed in this class, or to merely pass, I was forced to study organic chemistry every day due to the quantity and difficulty of the material. I enjoyed being challenged, even though it stressed me out sometimes. All in all, a seemingly scary class was made possible.

When students develop positive attitudes, learning becomes their first priority and they are focused to learn. Intensive format students have more stamina and motivation for learning than students in the traditional format. Students in the intensive format are more highly motivated than their counterparts in the traditional format. Some of the reasons for this increased motivation are that their increased performance is an indicator that they are more motivated. Secondly, they meet other students from varying backgrounds and institutions, and they receive personalized attention from professors and teaching assistants who are also focused on teaching and whose primary goal is educating the students.

How Well Do Students Perform?

The nationally normalized and standardized American Chemical Society (ACS) organic chemistry exam (10) was used to determine the effectiveness of both the traditional and intensive formats for students' learning and content mastery was by administering at the end of the two course sequence. The students in the intensive format out achieved those in the traditional format in all four years of the study. Most of the students in the intensive format scored above the national average of 40 points out of 70 points total (see Table 2 and Figures 1, 2, & 3). Given the similarity of the exams and quizzes in both formats, the performances of the students in the intensive format can be concluded to have surpassed those of the traditional format.

Table 2. Learning Outcome (ACS Exam) by Type of Format

	SISM 2003 (Intensive Course)	Anonymous university 2003-2004 (Traditional/PLTL)
Total # of students tested	25	21
Total # of students w. scores 40+	19	11
% of students w. scores 40+	76	52.4
	SISM 2004 (Intensive Course)	**Anonymous university 2004-2005 (Traditional/PLTL)**
Total # of students tested	18	25
Total # of students w. scores 40+	13	9
% of students w. scores 40+	72.2	36

Table 2. Learning Outcome (ACS Exam) by Type of Format (continued)

	SISM 2005 (Intensive Course)	Anonymous university 2005-2006 (Traditional/PLTL)
Total # of students tested	25	30
Total # of students w. scores 40+	13	7
% of students w. scores 40+	52	23.3
	SISM 2006 (Intensive Course)	**Anonymous university 2006-2007 (Traditional/PLTL)**
Total # of students tested	15	16
Total # of students w. scores 40+	8	8
% of students w. scores 40+	53.3	50

National Mean = 40 out of 70 points

Figure 1. SISM Learning Outcome (ACS Exam)

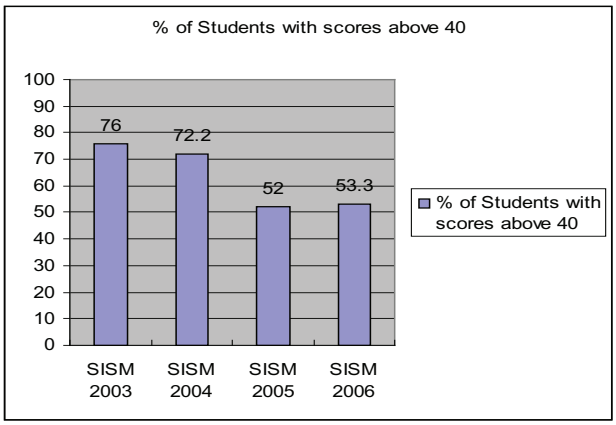


Figure 2. Traditional/PLTL Learning Outcome (ACS Exam)

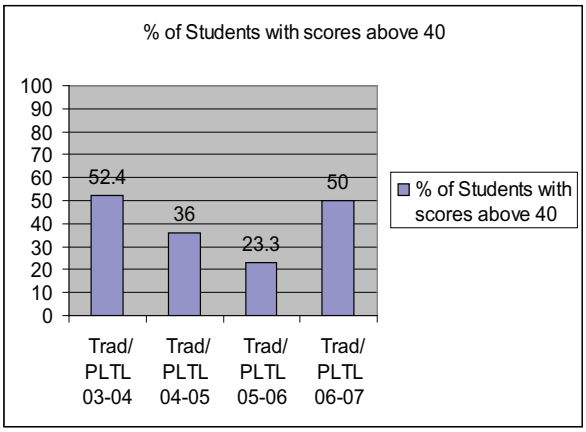
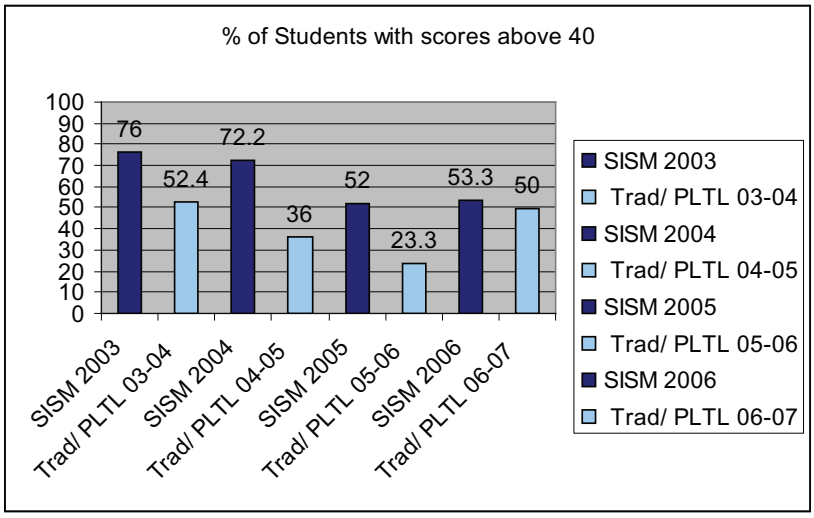


Figure 3. Learning Outcome (ACS Exam) by Format Type



Conclusion

Based on the data presented here it can be concluded that student learning of organic chemistry in the intensive format is more effective than the traditional format. Possible explanations for this outcome might be due to the fact that, the students in the intensive format have to focus only on one subject as compared to students in the traditional format where they have to deal with other courses. Students in the intensive format strive for excellence because the format allows them to deeply focus on one subject in an environment which stimulates learning—plenty of class time, expert instructors, peer tutors—and the stakes are high—they want to be doctors, they are paying (higher tuition) a lot for the course, etc. Also in the intensive format, any student with a grade below "C" is not allowed to take the second course. This is not the case with the traditional format where students usually take the second sequence with grades lower than "C." From the findings there is no doubt that the thinking skills of students in the intensive format improve more than the students in the traditional format. According to my findings, the greatest impact of PLTL was retention of students in the course. The number of Fs and Ds grades that were assigned in the course also went down.

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