How to Study a Course as a Project

For a student a course can be considered a project. There are a few technical terms used in a project and project plan. We introduce them after the discussion of a course syllabus.

Student's "Critical Chain":

Definition: "**A critical chain**" is the set of tasks which determine when a project can finish. They are critical because improvement anywhere in the Critical Chain means the project can get done earlier or better. It requires taking resource[1] capacity into account. Resource capacity is typically regarded as the constraint or leverage point of the project. A leverage point is an area where a small change can have a big positive impact on student's performance.

If you finish a project in time or early, you will build confidence for and credibility for others who wanted you to carry out the project. For a course, finishing early provides time for revisiting the ideas and get a deeper understanding. Sometimes, a mechanism is in place to study the next course and you might get a waiver or credit for that course.

The following example presents some ideas concerning the improvement of student services within the Department of Mathematics, as well as increased accountability and effectiveness of faculty and staff that resulted in fostering better communication among the students, the instructors and the tutors. Throughout the discussion, italics are used to describe roles as well as communication and performance measures.

Basic Goal: The Department of Mathematics offers academic programs that are tailored to the needs of the students of the College.
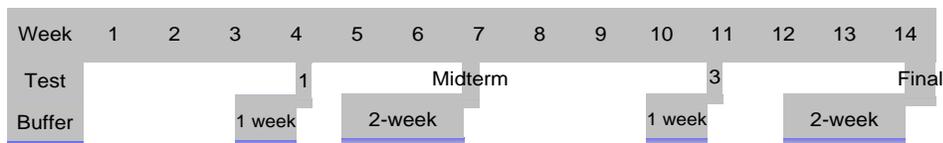
Assumptions: The working assumptions on which this discussion is based are as follows:
1. All persons with the Department (students, faculty and staff) want to improve themselves;
2. External recognition of a person's efforts at self-improvement can frequently lead individual to make greater and more sustained efforts toward improved performance;
3. Leading students to regard each of their course syllabi as a 14-week long project, putting responsibility on them to finish, and helping them to finish, will develop confidence in them and give them in training how to finish projects. Then they will also be able to complete other more complicated projects in life.
4. Students regard their teachers as a primary resource, the tutors as a supplementary resource, and computer web-based materials as secondary resources which they can use to finish the project at hand.
5. In any course syllabus, there is plenty of 'buffer[2]' allocated which doesn't necessarily have to be used on all topics. But the students should try to finish as many lessons as they can and use the usual one week buffer before a test only for mastering the difficult topics.

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[1] Discussed in detail after the syllabus for a course. But basically resources are those people or items that support student's study or in short "student's support team and supplemental software."

[2] A buffer is a time put into the schedule systematically in order to protect against unanticipated delays, and in order to allow early starts. Buffers are essential parts of the schedule. These ideas are also discussed after the syllabus.

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Test				1			Midterm				3			Final
Buffer			1 week		2-week					1 week		2-week		

- Each student coming for tutoring is given the list of tasks or topics using the syllabus for the appropriate course (example on a later page of the appendix.)
- Copies of all syllabi from Intermediate Algebra to Calculus I are available in the Department. The last three columns of the syllabus are for the signatures of the student, tutor and instructor after completion of a set of topics. Students and tutors must also have the scores of various class tests at the end of completion of an appropriate set of topics.

  After a student finishes a topic, s/he makes a point in the green area if s/he has finished it before the instructor does, in the yellow area if s/he finishes it with the instructor or within one week after the instructor's, and in the red area if s/he finishes more than one week after the instructor does. Connect the points as you go. If the curve is completely in the green area then you are running your course effectively. Otherwise, you need to come to the green area as early as possible. This graph shows student's visual progress curve during the semester.

  The instructor is provided with these copies as well, so as to get an idea of what service the tutors are offering to their students. The instructor knows that s/he is the primary facilitator for the course and the tutors are supplementary facilitators. The instructor makes an effort to contact several tutors for his/her course, to acknowledge that the tutor's service in individualizing help to students is valuable. This will help to maintain communication between the student, the tutor(s) and the instructor. The instructor communicates the assumptions stated at the beginning to students.

  The Department measures i) the pass rate of class ii) the class average score on each test iii) ratio of passing rates to tutorial expenses for a course and keeps track of these numbers using a computer database along with the number and list of students in courses taking tutoring, all tutors and instructors.

- It usually happens that a student comes for the first time right <u>before a test</u> to get a sample test solved by the tutor. The tutor should not solve the problem but help the student solve the problem by asking questions – to see the steps where the student has the difficulty. This pinpoints the student's difficulty. The tutor then should take out the <u>problem set</u> for the course, if the student has not been given one, and along with helping the student on a particular problem, get several problems on the given topic from the problem set. This should continue until all problems related to the sample test are solved.

  The Department has more tutors available during the week before, after the midterm and two weeks before the final.

The instructor and tutor emphasize to the students that sample tests are given for the students to develop their test taking skill, so instead of solving that sample test first, they should use the problem set to do a lot of problems, get ready for the test and then take the sample test as a mock test at home while timing themselves without looking at any text or notes. To finish more or all questions on any test in a given time period, the student should look at the entire test first, do the easy problems and then go on to difficult problems, even going out of the sequence in which problems on the test are given.

- Along with the scores on a test, the instructor indicates to the student topics where the student has difficulty. If an error is made, it is so indicated to the student and also whether the error is due to not understanding the topic, carelessness or lack of time. If students come to tutoring the first time <u>after a test</u> bringing their tests with them, the tutor should ask them to mark the topics from their list of topics (syllabus form) where they made their mistakes. The tutor should require them to do that problem again, and check where they have difficulty. The tutor should then help students do more problems on the topic in question from the problem set. As far as possible the effort should be more of the student than of the tutor.

- About 10% of the students do well in a course and are bored by the pace of the course. They must be given a choice: 1) Work with students who are not doing well in their class, even outside of class time, because while helping others they will improve their own understanding, or 2) If some students want to finish all topics early, the students are encouraged to work with a tutor on a regular basis, studying the topics from the book by themselves, showing the tutor his/her work on the problem sets. They must attend the classes, since an instructor gives an insight into or easy methods of working on a topic which they might not get by studying themselves. They take their tests along with other students in the class. In addition, if the students are basically finished with all lessons from a course, arrangements should be made for the students to get in touch with an instructor of the next course, complete the set of lessons from that course and also take tests in the tutorial area from the instructor. They should take their finals with the appropriate instructors. Students who do this should be given an exemption (not credit for the course not taken) from the next course by the Chair and should be placed in a more advanced class. We have examples of students in the past finishing two courses in one semester.

- **In each of the above cases, a lesson-by-lesson course syllabus is carried by a student attending tutoring. The student initials in front of the topics and get the initials of the tutor on the topic(s) and shows it to his/her instructor who initials the form at the appropriate places and give it back to the student.** This classification can give rise to numbers ahead, on time, or falling behind for the student database, and focuses on students who need intervention from tutors, instructor and counselors. For a record of progress of all students coming for tutoring, the tutorial coordinator, with the help of an assistant, enters once a week in the database number of students according lagging behind, absent/about to fall behind, and going ahead of the course schedule. [3]

An Example of a syllabus is provided on the next page. A sample progress curve for a student is given at the end of the document.

SYLLABUS FOR College Algebra and Trigonometry - MTH 138 Section _____
NAME:_____ Name of Instructor: _____

Lesson	Topic	Section/s	Student/Date	Tutor	Instructor
1	Linear inequalities, compound inequalities	1.7, 1.8			
2	Functions	2.2, 2.4			
3	Absolute value equations and inequalities	2.6			
4	Slope, distance, and linear functions	2.7, 2.8			
5	Systems of equations in two variables	3.1			
6	Systems of equations in three variables	3.2			
7	Introduction to trigonometry	4.1			
8	Right angle trigonometry	4.2			
9	Trigonometric functions of any angle	4.3			
10	Trigonometric equations	4.4			
11	*TEST 1*	**Score**			
12	Review of factoring	5.1, 5.2			
13	Solving polynomial equations	5.3			
14	Review of arithmetic with rational functions	5.4, 5.5			
15	Complex fractions	5.6			
16	Division with polynomials	5.7			
17	Equations with fractions	5.8			
18	Radicals	6.1			
19	Rational exponents	6.2			
20	Computations with radicals	6.3			
21	Further computations with radicals	6.4			
22	*DEPARTMENTAL MIDTERM*	**Score**			
23	Complex numbers	6.5			
24	Completion of the square	7.1			
25	Quadratic formula	7.2			
26	Discriminant, word problems	7.2			
27	Equations that lead to quadratic equations	7.3			
28	Parabolas	7.5			
29	Circles	7.6			
30	Ellipses and hyperbolas	7.7			
31	Nonlinear systems of equations	7.8			
32	*Test 3*	**Score**			
33	Exponential functions	8.1			
34	Inverse functions	8.2			
35	Logarithms	8.3			
36	Properties of logarithms	8.4			
37	Logarithmic and exponential equations	8.5			
38	Applications of e	8.6			
39	Sequences	10.1			
40	Series	10.2			
41	Infinite series	10.3			
42	*Test 4*	**Score**			

DEPARTMENTAL FINAL EXAM Score

Details of technical terms in CCPM of a course.
1. Student receives a syllabus for the course - the topics s/he is responsible for. This is the set of tasks. The student should know the goal of the course, how it is relevant for his/her career/specialization. (The student should seek clarification from instructor/tutor, since it is not possible to list all relevancies in the syllabus.)

   The Goal of every mathematics course is to master the concepts and skills listed in the syllabus so as to use the knowledge immediately in the next courses for which a particular course is a prerequisite. The goal while learning a course is to link the ideas logically so as to form a mental picture of the course and not a set of isolated facts or rules. The long-term goal of mastering mathematics is to develop logical way of thinking to be able to use in studying any subject and in life.

   This is the critical chain for each student. The student has to know his role, instructor's role and tutor's role. The student has to also know if there are supplementary materials available on the web. The instructor and tutor must know their roles as facilitators.

2. Resources: Instructor is the primary resource and tutor is a supplemental resource to facilitate achieving the knowledge of the course. Every tutor and instructor must make it clear to the student that they are only facilitators and it is the student's responsibility to acquire this knowledge and it is to his/her benefit to make use on a regular basis of their availability and follow up on their directions. We are also in the process of providing computer resources for courses up to Precalculus by making the web courses available so that the student can access the materials 24/7.

3. There is a project tracking involved: STATUS - What is being covered, how much is yet to be covered. EVALUATION of STATUS: What are the difficulties on current and past topics? How much is the score on the class exam/s and the midterm? What exactly are the mistakes made on a sample test, actual test, etc.?

4. **Importance of Tutor:** The tutor can help the individual student manage the project, whereas the instructor does not have sufficient time to individualize the process of learning as s/he has the responsibility of instruction of mainly the course content. The tutor can help student track the project - focus on the student's exact mistakes on the test and correct student's understanding.

5. **Scheduling high-risk tasks:** Topics such as Trigonometry and Exponential Functions and logarithms are important in College Algebra/Trigonometry and Precalculus and if instructor puts them to the end of the syllabus they get done in a hurried manner with no deep understanding on students' part. They have to be covered early in the syllabus. Some instructors, including myself, make sure that they cover these topics as early as possible. By doing this if a student has not understood the concepts there is time to help him/her. In any other course, looking at the syllabus the instructor can decide the high-risk taks and place them early.

6. **Buffer Management:** Definition of buffer: It is time put into the schedule systematically in order to protect against unanticipated delays, and in order to allow for early starts. They are usually parts of the schedule. Buffers are not slack. Slack is a free time available to

move a task later. There are four types of buffers – Project buffers, feeding buffers, resource buffers, and strategic resource buffers. Buffers are an extremely valuable tool for monitoring the status of projects and determining whether drastic actions are required.

Every course syllabus arranged day-to-day has built-in buffers – not arranged systematically – but the average time to complete a topic. For instance, there is flexibility on the part of the instructor to cover a certain topic in more or less than the indicated day or duration in the syllabus. Experience shows that the instructor finishes topics for a test about a week earlier. If an instructor is absent on a certain day, there is a time buffer, not mentioned, but to cover the topic and the rest in the remaining periods. Similarly, the student if absent for a particular class can cover the missed topic on his/her own or with the help of the resources available in a reasonable time.
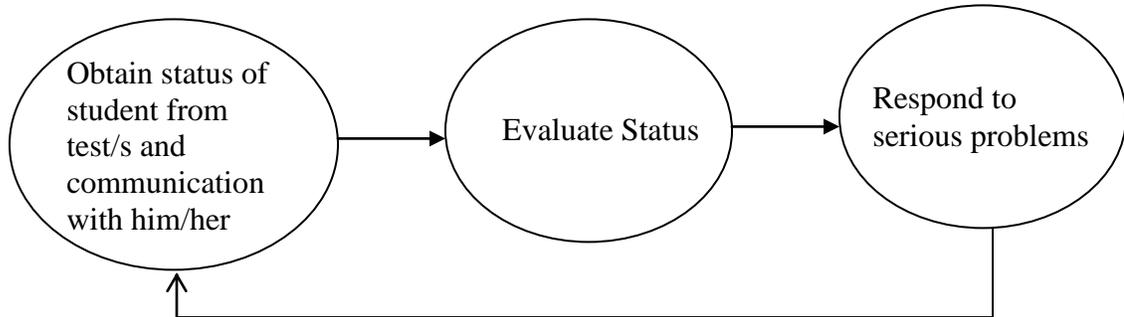
If the buffers are arranged in a more systematic manner as project buffer, etc. instead of spreading it out throughout the syllabus, the student can complete the topics on his/her own or with the help of the resources. From this point of view, place the **project buffers** of one week or usually half the time allocated the tasks before the test. The student should finish all tasks – studying the prescribed topics - one week before a class test, ideally in half the time allocated for the topics in the syllabus. In the week/s leading to the test, the student should take various sample tests, old tests and work on the areas that are perceived as difficult. For the final exam, the student should have a two week buffer. In this manner, avoid the stock phrase of 'student syndrome', where a student starts studying a day or two before a test. If a student does not have difficulties and is finished, the student should be given reinforcement/enhancement material to study which an instructor can make available to student. (In the past, for at least ten students at different times, some instructors have given the topics of the next course in the course sequence and most of them finished and ended up taking the final exam for the next course also. The Department gave them a waiver, but no credit, for the next course. Most of them did A level work in both courses! Thus a student was not restricted by a policy constraint of taking only one course per semester.) This requires constant communication between student, tutor and instructor.

The project buffer needs to be checked, and if it is being used up doing certain tasks, extra help in terms of instructor and tutor intervention has to be taken so that the tasks are finished before the project buffers are used up.

Feeding buffers: These buffers make sure that supplemental work is available if a student needs. Thus giving the students departmental selection of test preparation problems is adequate. If a larger variety of problems is available the course becomes richer and student has more practice materials. From that point of view faculty should keep enhancing the set of problems.

Resource buffers: If a student needs extra help/time to finish the task before the project buffer begins, the instructor/tutor should make more help/time available as the need arises. The resource buffer is like a wake-up call.

7. **Information Flow:** The information flow to manage buffers is as in the following. It is nothing new. We do this check even now. What is different here is the introduction of the three buffers and making student aware of his/her responsibility.

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┌─────────────────┐      ┌─────────────────┐      ┌─────────────────┐
│ Obtain status of│      │                 │      │                 │
│ student from    │ ───► │ Evaluate Status │ ───► │ Respond to      │
│ test/s and      │      │                 │      │ serious problems│
│ communication   │      │                 │      │                 │
│ with him/her    │ ◄──────────────────────────────────────────────┘
└─────────────────┘
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Multiple Courses: Develop a "realistic schedule." Approach counselors and advisors to help you. Take a balanced set of courses – some technical and some not, but not all hard or all easy. Manage the project and resource buffers, use the days when the course does not meet and weekends to complete the various tasks of each course.

If you practice the principles discussed here, you will enjoy every course. You might be able to complete more courses and finish your required courses earlier.

SYLLABUS FOR College Algebra and Trigonometry - MTH 138 Section _____

NAME:_____ Name of Instructor: _____

Lesson	Topic	Section/s	Student/Date	Tutor	Instructor
1	Linear inequalities, compound inequalities	1.7, 1.8	SH. 2/1	PA. 2/1	TB. 2/4
2	Functions	2.2, 2.4			
3	Absolute value equations and inequalities	2.6			
4	Slope, distance, and linear functions	2.7, 2.8			
5	Systems of equations in two variables	3.1	SH. 2//10	PA. 2/10	TB. 2/11
6	Systems of equations in three variables	3.2			
7	Introduction to trigonometry	4.1			
8	Right angle trigonometry	4.2			
9	Trigonometric functions of any angle	4.3			
10	Trigonometric equations	4.4			
11	*TEST 1*	**Score**	75 2/25		
12	Review of factoring	5.1, 5.2			
13	Solving polynomial equations	5.3			
14	Review of arithmetic with rational functions	5.4, 5.5			
15	Complex fractions	5.6			
16	Division with polynomials	5.7			
17	Equations with fractions	5.8	SH. 3/15	PA.3/15	TB. 3/17
18	Radicals	6.1			
19	Rational exponents	6.2			
20	Computations with radicals	6.3			
21	Further computations with radicals	6.4			
22	*DEPARTMENTAL MIDTERM*	**Score**	85 3/18		
23	Complex numbers	6.5	SH. 3/31	PA.3/31	TB. 4/1
24	Completion of the square	7.1			
25	Quadratic formula	7.2			
26	Discriminant, word problems	7.2			
27	Equations that lead to quadratic equations	7.3			
28	Parabolas	7.5			
29	Circles	7.6			
30	Ellipses and hyperbolas	7.7			
31	Nonlinear systems of equations	7.8	4/ 2	PA. 4/13	TB. 4/15
32	*Test 3*	**Score**	96 4/18		
33	Exponential functions	8.1			
34	Inverse functions	8.2			
35	Logarithms	8.3			
36	Properties of logarithms	8.4			
37	Logarithmic and exponential equations	8.5			
38	Applications of *e*	8.6	SH. 5//10	PA. 5/10	TB. 5/12
39	Sequences	10.1			
40	Series	10.2			
41	Infinite series	10.3			
42	*Test 4*	**Score**	84 5/19		

DEPARTMENTAL FINAL EXAM Score 92