# The Course Syllabus: A Powerful Instrument to Develop Student Collaborators via the Renaissance Foundry

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## Abstract

This contribution in progress focuses on describing a pedagogical protocol or mechanism for helping students to draft an updated syllabus of a chemical engineering, transport phenomena course focused on an infused technological curriculum implemented in a medium-sized, regional university. The protocol is geared toward the implementation of an inquired-guided approach that helps students implement collaborative and efficient approaches to draft a new and updated syllabus from a traditional version submitted by the instructor. The activities detailed are guided by the implementation of the Renaissance Foundry Model, an innovation-driven learning platform. Preliminary comments from the application of the protocol are offered with pointers for further work.

## Keywords

Collaboration, Syllabus, Student-Collaborators, Renaissance Foundry Model, inquired-guided learning, POK

## 1. Introduction:

In traditional teacher-centered learning environments, contractual syllabi are typically adopted wherein the emphasis is placed on the contractual nature between the instructor and the students, highlighting the pre-determined nature of the implementation of the course requirements and policies[1]. Studies have shown that using such syllabi elicit various levels of engagement, perceptions, and expectations for students as the opportunity is lost to collectively identify what would be the most beneficial aspects of the course and how these aspects should be evaluated by students themselves[1,2] . Further, the argument can be made that within collaborative and active-learning frameworks, which center on student learning, adopting a traditional syllabus runs counter to the presupposed notion of student engagement in this environment[3]. Consistent with the critical aspects of collaborating would be the design of a different syllabus by working with students as a team to achieve an agreement of cooperation for learning the key aspects of the course and between the instructor and the students on how the material will be presented, how the students will be responsible for their learning, and, ultimately, how the course should be assessed. In this work in progress, details of an approach to student-designed syllabi as implemented in a chemical engineering, transport phenomena course will be detailed. Building on the scholarship supporting student-designed syllabi, this unique approach leverages the Renaissance Foundry Model (herein the Foundry) to elevate the type of collaboration engendered by this approach as embodied in the development of the syllabi as a prototype of innovative technology[4]. A preliminary analysis of the performance of students in the course along with student feedback will be presented to help understand the benefits of this approach within a Foundry-designed course.

## 2. The Foundry Model – A Brief Overview

The Foundry model[4,5] is an innovation-driven learning platform that helps students to organize their activities to identify a problem (i.e., the Challenge) and develop a plan that leads to an appropriate outcome (i.e., the Prototype of Innovative Technology [PIT]) that addresses such a challenge. The students are equipped with six key elements to transition between these two ends, from the selection of challenge until they collaboratively work towards the building of a PIT, organized into two learning paradigms, e.g., the Knowledge Acquisition and the Knowledge Transfer paradigms. In addition to the challenge and PIT, these paradigms encompass the other elements including, the Organization Tools, the Learning Cycles and the Learning Engineering Sequence (LES) that all pivot around the Resources. This central Foundry element supplies both sources of information and skills useful to assist the students to implement their activities towards collaboratively identify a given learning challenge and then proceed with the development of the PIT.

The Foundry works sequentially but iteratively between the two paradigms guiding the students to acquire knowledge and transfer this knowledge focused on understanding the challenge and making progress towards the building of the PIT. A helpful mimic is that the Foundry is an engine with two pistons, i.e., the paradigms that working together move the students on their journey towards building the PIT after the challenge has been identified. This engine is a facilitator or tool of the different activities that students may want to design and implement during their trip from the challenge to the PIT; however, this engine does not impose on the students where to stop or go back and retake their trip towards the PIT. Indeed, two different teams of students could take very different strategies to select a challenge and arrive to their PIT, always moving forward. The Foundry has been applied successfully to different courses, service-learning programs, and, recently, to the remodeling of a chemical engineering curriculum to help develop a new type of professional - one that is innovative, holistic, socially responsible and with an entrepreneur mindset[6,7].

## 3. Goals and Key Steps in the Guiding Mechanics of the Syllabus Drafting:

The description offered above is helpful to guide the drafting of a syllabus as a potential tool and strategy for a transport phenomena course, i.e. ChE ChE 3050, Transfer Science-I, as guided by the application of the Foundry Model. Herein we describe key aspects of the mechanics or, alternatively, the *pedagogical process* we used to guide and implement the Foundry as a guiding tool in drafting the collaborative syllabus for this course. The key goal of this work in progress is to present the key steps (Table 1) associated with the mechanics of guiding students to develop and draft a syllabus to be used as a guideline tool in all activities related to the ChE 3050 Transfer Science I. This course is described as a 3-credit course of the chemical engineering curriculum of a medium size and regional university, i.e. Tennessee Technological University, that offers a technologically infused-style curriculum where technological applications permeate the different majors across campus.

To begin, we ensure that our students have a strong foundation in the understanding of the elements that constitute the Foundry Model and the general strategy on how to use them to effectively achieve a Prototype of Innovative Technology. The Foundry is introduced in the curriculum early, at the freshman level within an introduction to chemical engineering course[8];

therefore, when students enter ChE 3050, they are familiar with the general aspects of the model and, as a reinforcement, they are asked to review the key article describing the Foundry. Anchoring our work in the Foundry, we present the following question as a class challenge:

*What would be an efficient series of guiding steps following an inquiry-guided approach (for students) to draft a useful syllabus that can be used as a guiding tool for the student-centered learning activities of the course? These activities include, for example, classroom learning exercises, course projects, assessments, and documentation protocols within the entire semester.*

To answer this guiding question, a series of activities (outlined in Table 1), encompassing the mechanics of drafting the syllabus for this course, are implemented. These mechanics are couched in inquiry-guided exercises[9] coupled with the Foundry as a platform to facilitate student understanding of the challenge and the creation of a PIT (i.e., new syllabus). It is important that this exercise is a learning process with a fluidic exchange of ideas in order to move the different "proposal" toward to the achievement of a PIT within a collaborative process. In this environment it is a naturally action to discuss ideas, modify them, or simply change them for others that collectively are thought to be more promising.

Step 1 of the table is very helpful to review basic aspects of the Foundry and inform students of the different elements that this platform offers. Step 2 is vital so that students understand the key target of the activity; this is usually completed partially in class with students working as a team to gain a clear understanding of the expectation of the activity. Step 3 is a very helpful starting point so that students have a clear understanding of the course content and the various aspects and activities proposed by the instructor to achieve the learning of the course objectives. Step 4 is the next logical step where students acquire a clear understanding of methodology, targets, and expectations to then work on drafting an updated version of the syllabus. In general, students are encouraged to question every aspect of the syllabus with reasonable arguments, although they usually focused more on the activities, protocols, and assessments. Step 5 offers feedback from the instructor to requested clarifications, make suggestions regarding aspects where the draft is short of presenting a clear plan, and comment on discrepancies concerning the alignment of student commitments to their responsibilities for the different activities. Step 6 affords an opportunity to exchange useful ideas from the students and the instructor to make progress toward an effective PIT for the course. Step 7 is the potential final step from the students to write an updated draft with improvement towards a more efficient PIT for all parties involved. Usually, this is a point where students and the instructor have the chance to decide on whether further adjustments for improvement are needed.

## 4. Preliminary Observations:

The different steps included in the mechanics described in Table 1 form a useful protocol to guide and support students as collaborators in a series of activities that result in drafting a new and mutually agreeable syllabus between students and instructor. Comments from the students indicate that these series of activities also facilitate the acquisition of a deeper understanding of the course content; they work, effectively, as a "Principal Object of Knowledge (POK[10]) for the students in acquiring a firm conceptual structure of the course material. They also help students to better understand what learning exercises would be beneficial to achieve a successful mastering of the learning objectives of the course. In addition, the role of the Foundry facilitates

students' work and their focus on meaningful activities from the understanding of the challenge (i.e., the new syllabus) and what is needed to achieve the draft of an updated version. During the oral presentations illustrations of how this outcome is achieved by organically including students in the process of designing and drafting a syllabus that represents the class view in a collaborative fashion will be offered. Additional work is needed to determine the extent of the student improvement related to critical thinking skills related to their responsibilities in committing time and effort to learn the course content at a level useful for their major.

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**Table 1: Key Steps of the Inquiring Level Strategy to Guide Students in the Drafting of the Course Syllabus**

| Step | Focus | Comment |
|---|---|---|
| 1. Review of the Foundry Model via a collaborative discussion with students | Acquisition of knowledge of key background aspects; review of the Foundry elements and paradigms, i.e., the KAP & KTP | The Foundry Model is used as the guiding learning protocol for students to collect information, identifying the challenge and develop the PIT, i.e. a modified and collaborative instrument for the course |
| 2. Discussion with Students to clarify any aspect related to the challenge and the | Meetings with students to facilitate understanding of the resources at their disposal and the key role of the KAP & the KTP | Students need to understand the key differences between the different type and objective of the syllabus for courses |
| 3. Handout of the "Traditional Syllabus" | This part of the learning question is about student understanding the base line of the challenge | As the students are usually familiar with the "traditional syllabus", the instructor hands out and discuss it this document as a starting point |
| 4. First version of PIT from the students | This is the first step in achieving a PIT by modifying the traditional syllabus handed out to the students | After students have been overview of the method, the traditional syllabus and potential targets are understood, they work on their first draft. |
| 5. Input from the instructor | Feedback from the instructor for potential corrections and adjustments | The first draft from the students contains several aspects that need adjustment and the instructor offer feedback to achieve these. |
| 6. Second Iteration from the students. | Students have discussions and exchange of ideas to improve first draft | It is a very effective ways for the students to have discussion with the instructor to learn aspects that need improvement |
| 7. Students draft an updated draft | Students need to implement adjustment and submit an updated draft | After all aspects have been understood, students focus on adjusting the previous draft to improve the PIT they have produced |