

# Research Learning Contracts: A Useful Tool for Facilitating Successful Undergraduate Research Experiences

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## Introduction

Over the past twelve years I have mentored thirty undergraduates and thirteen minority high school students in my research group at Northeastern University. Northeastern University is an urban graduate research university located in Boston, Massachusetts, is best known for its emphasis on cooperative education. Because undergraduate research played such an important role in my own career path, I have made a strong effort to involve undergraduates in meaningful ways in my own research program. Consequently, it may come as no surprise that almost a third of the thirty-six peer-reviewed publications from my lab have been co-authored by younger students — either high school students or undergraduates. Over the years the size of my group has been relatively small and has varied anywhere from three to, in more recent years, ten and included postdoctoral associates, graduate students, undergraduates, and high school students. While some of my younger students have been group members for as long as five years, the majority participate for less than one year. Therefore, it has been important to me to find ways to maximize student learning and productivity. I have found research learning contracts to be particularly useful tools in this regard.

## What are Research Learning Contracts?

In my view, learning contracts may be viewed as covenants, ideally designed jointly by the faculty sponsor and student at the outset, that define the research experience, and in the process promote mutual inquiry and accountability between the faculty sponsor and the younger student. Learning contracts are not a new kind of teaching tool. They have been used in higher education (1,2) for over a quarter of a century perhaps most frequently as alternative assessment tools in clinical education (nursing, pharmacy, and medical) (3,4), and in science laboratory courses (5-7). Learning contracts lend themselves particularly well to learning opportunities that are relatively unstructured and highly individualistic. Consequently, they can be extremely useful in crafting quality undergraduate research experiences. Since learning contracts are inherently process rather than content driven, they are not discipline specific and can be readily adapted for use by any field. If you do not use research learning contracts, you are not alone. In a recent national survey of 1075 chemistry faculty members at public and private graduate research, comprehensive, and four-year colleges sponsoring undergraduate research

students in their laboratories (163 institutions; 50 states, the District of Columbia, and Puerto Rico) (8), 14% of the 258 faculty respondents indicated that they use a research learning contract.

Research learning contracts are generally concise (one to two pages in length), typewritten documents that summarize the undergraduate student's responsibilities, learning objectives, project evaluation criteria, and any deadlines — in short, anything that helps the faculty sponsor and/or the student to define their relationship so that it promotes student learning and research productivity. An inventory of some information that may be included in research learning contracts is provided in Table 1. Figure 1 provides a sample learning contract for a returning undergraduate student that can be used as a guide in preparing your own.

It is important to state at the outset what research learning contracts are not. They are not syllabi, i.e., one-sided; created by faculty and given to students; unlike syllabi, students do have a say in what is put into the learning contract. Learning research contracts are not research proposals. Learning contracts typically do not contain a literature review, a detailed description of the project, a budget or budget justification. Learning contracts are also not alternative mechanisms of assessment. They are process-driven documents that facilitate as well as assess student learning.

I do not typically use a standard form when creating a new research learning contract with a student as I find most too limited and restrictive in format. Each of my students is different, their learning needs are distinctive, and their projects are also unique. Consequently, I prefer to have each student shape his/her own research learning contract. Instead of supplying them with a general template, I provide new students several research contracts authored by other current or former undergraduate group members. I then outline for each new student my vision for their project, my expectations, outline any time limitations on my end, and then allow the student to create the first rough draft.

If you have not previously used a research learning contract, however, you may prefer to use a template the first time you use this teaching tool. A number of institutions have relatively short and easy to use forms that you can readily adapt for your and your student's use (9-11). One of my favorites is Macalester College's form (10). It is very simple, flexible, and

contains thoughtful questions that will help both the student and the faculty advisor craft a contract that supports independent learning. For each learning objective, the student must identify the strategies, evaluation methods, and target completion dates he/she will use to achieve each learning objective. The form also includes several questions intended to help the student think reflectively about the experience (or lack thereof) they bring to the project, what resources they will need in order to accomplish the project, and how their project will be evaluated. If you do choose to use a template, I strongly suggest that you do not let the template form determine what information you and your student may wish to include.

## Good Practices to Follow When Using a Research Learning Contract

Over the years, I have learned that there are some good practices to follow in creating a research learning contract that really works. First, it is best to formulate a working research learning contract the first week or two that the student joins your research group. Doing this at the outset of your relationship ensures that everyone understands what the project really is and who will do what when. It also helps to avoid misunderstandings in the long term regarding expectations, etc. I have also found that it works best if the student writes up the research learning contract. This provides the student with a sense of project ownership at the outset of the project. From the student's write up, I can quickly determine whether or not the student really understands what his/her project is and whether they see the "big picture" — how their research project fits into my research program. Areas of confusion can be more quickly identified and corrected at the outset and student missteps avoided. Another benefit is that students are less likely to over commit themselves if they must set their own work schedule.

Flexibility is the key. Some students may want more; other students may need less. This said there is a minimum of information that should be provided in the research learning contract if it is to be effective/valuable. The information appearing in italics in Table 1 constitutes what I view as the minimum content required for a research learning contract to be effective and meaningful in defining the project and the student-faculty sponsor relationship. Depending on the student, whether they have prior undergraduate research experience, etc., the research contract may contain more or less information. How much is necessary is dictated both by the individual perceptions and needs of you and your student. Mature students and repeat students will likely need shorter, less detailed contracts while new research students will benefit from longer, more detailed learning contracts.

The student should be encouraged to include his/her contact information in the research contract. This enables you to contact the student if the student disappears unexpectedly from the lab due to illness or over-commitment, if you need

to change the agreed upon weekly meeting times, etc.

I also believe it is extremely important to provide a job title for the student no matter the nature of our working relationship (i.e., for pay, academic credit, or volunteer). This professionalizes your relationship and helps students to see their experience as a real job rather than one more academic exercise. The contract should specifically state the form of your relationship with the student whether the student is salaried, working for academic credit, or volunteering. If the student is salaried, you should discuss the salary and the agreed upon rate of pay should be included in the research learning contract. If the student is working for academic credit, you should discuss exactly what the student will be expected to do to earn a letter grade and how specifically that work will be assessed.

The bulk of the research learning contract should provide useful information concerning the nature of the agreed upon research project and nature of your working relationship. You and your student should include a descriptive title for the project (preferably crafted by the student), a statement of the project goals (long term), objectives (short term, bite-size, achievable), a list of what will be done to accomplish these objectives, and deadlines for their accomplishment. Over the years I have found that my students are keenly interested in knowing what specific skills they will develop, what new techniques they will learn, and what specific research grade instruments they will use in accomplishing their project. This represents a value added investment for students in terms of skills and experience that students can list on their resume. We also create a table listing the amount of time we think each task will take, what resources will likely be required in order to accomplish each task, what experiments will need to be done, and what specific experimental evidence will be required in order to decide whether or not each task has been successfully accomplished. Target dates should be included for the accomplishment of each task. If properly created and used, creating the table puts the student in control of their own learning — it allows them to control what they learn, when they learn it and how quickly and under what conditions they learn it.

The student should be encouraged to commit to a regular weekly work schedule and this work schedule should be outlined in the research learning contract. If any specialized safety training is required for the student's project, I have found it extremely valuable to discuss this with the student up front and to include mention of these considerations in the research learning contract. The student should be encouraged to include mention of any resources or materials that he/she feels are needed in order to accomplish the research project. This could include a request for training on and access to a new instrument, a weekly de-briefing meeting, at which the student has an opportunity to present his/her work and obtain meaningful feedback regarding research progress, etc.

Although not essential, I find it highly beneficial to discuss

**Table 1. List of Information Typically Found in a Research Learning Contract**

<b>Student's name and contact information</b>
Address
Cell phone
E-mail
Date prepared
<b>Job title</b>
Professor's assistant
Research assistant or research associate
<b>Mechanism of employment</b>
Pay (salary, work study)
Academic credit/thesis
Volunteer
<b>Project title</b>
<b>Goal</b>
<b>Methods</b>
Skills to be acquired/exercised (resume)
Knowledge/training to be acquired/exercised (resume)
Instruments used (resume)
<b>Work schedule</b>
Responsibilities of student
Time/tasks
Safety considerations
<b>Resources and assistance</b>
Responsibilities of faculty advisor
<b>Time/tasks</b>
Other needed resources
Access to instrumentation, facilities, etc.
Purchase of reagents, materials, etc.
<b>Outcomes</b>
I will have accomplished objective X when
I have made Y or measured Z...
<b>Opportunities</b>
Standard operating protocols (SOP's) (carrots)
Publications (carrots)
Any pre-requisites
Presentations (carrots)
Any pre-requisites
<b>Assessment/evaluation plan</b>
<b>Signatures and dates</b>

and include in the research learning contract what I call "carrots," potential opportunities for public presentation of our research results which typically include poster presentations at regional or national conferences and publication opportunities. Discussing the requirements for co-authorship upfront in the early days of our working relationship conveys to the student that I have high expectations for their success and that I am willing to commit more than verbiage to their success — money for travel to meetings, opportunity for co-authorship, etc. At the same time it allows me to define my requirements for co-authorship on publications, travel support to meetings to present the work, etc.

If we wish to learn and grow ourselves as educators, it is essential that we are committed to assessing the efficacy of our endeavors. Consequently, I always discuss with my student how we will assess our time together. In terms of assessing my student's success, I usually ask them to commit to write a technical paper describing their accomplishments which follows the ACS Style Guide (12). In terms of assessing my efforts, over the years, I have developed a survey tool, a modified version of our standard student course evaluation tool, which I administer to my students at the end of their time with me. I also like to engage in a final debriefing session in which I ask students to candidly share their views with me including the areas in which they feel I could improve as a faculty mentor.

It may take several revisions before both you and your student are satisfied with your research learning contract. Revision is healthy and in fact invaluable. It sets the tone from the outset that you view the contract as a living agreement subject to re-negotiation, as necessary, rather than a chiseled granite tombstone. Research learning contracts should be reviewed at agreed upon intervals (I like to use a monthly basis for quarter-based undergraduate research experiences and a quarterly review for year-long projects). This gives both the faculty advisor and the student needed "wiggle room" in case obligations or expectations on either side are for some reason off-target and it ensures that the lines of communication are open from both sides. These opportunities provide students with meaningful opportunities for self-reflection regarding student interests, career goals, and/or emergent learning needs.

It is also extremely important that both the faculty mentor and the undergraduate student both sign the research contract. This ensures mutual accountability for the expectations and obligations outlined in the contract. Each should keep a copy of the contract on file.

Finally, the research contract should be revisited at the end of the undergraduate research experience. Both the student and the mentor should assess how well they have met the expecta-

tions and obligations outlined in the contract. Based on this discussion, a written assessment of the student's contributions to the project goals and of his/her performance is prepared. When done thoughtfully, my students are usually very happy with their research course grades. In addition, I have found this appraisal to be a useful foundation on which to base substantive student letters of recommendation for advanced study, scholarship applications, and job applications.

## Benefits of Using a Research Learning Contract

The research learning contract presents many benefits to the faculty advisor. Defining a contract as I have outlined above, in which the student co-authors the contract, sets the tone of the student-mentor working relationship — trust, partnership, team spirit, flexibility, mutual accountability, and interdependence. Using a learning contract helps to encourage student ownership of the research project right from the start. It supports individualized student learning by allowing the student with the opportunity to structure the working relationship so it best meets the student's own unique learning needs. It also provides the student with an opportunity to define what they need from their faculty mentor in order for meaningful learning and research productivity to occur. For some students, this might simply represent a commitment to a weekly meeting between the advisor and the student. For other students this might represent a commitment from the faculty advisor to provide training on a new instrument or in using an experimental method or technique new to the student. Education research suggests that these characteristics are extremely important in adult learning and that learning will occur more deeply and be retained much longer when self-directing methods are used (1,2).

## Cautions

Most of us view contracts of any kind in a somewhat negative light. We usually think of contracts as one-sided, restrictive, and inflexible. Consequently, it should not surprise us that students may be very leery at first of using something called a research learning "contract" to define their undergraduate research experience. For this reason, it is really important not to use the research contract the way some faculty wield a syllabus like a bully stick used to hit recalcitrant students over their heads. The research learning contract should not become a list of one-sided contractual obligations, all of which rest on the side of the student learner. It is beneficial and, in my view, essential to revise and re-negotiate the research learning contract so it fits your and your students' constantly evolving and changing working and learning relationship. Be sure to critically examine the research learning contract and make sure that students do not overestimate their abilities and underestimate their outside obligations and the time they have

## Figure 1. Sample Research Learning Contract

[Student's name]

[Advisor's name]

[Date]

[Title of Project]

UV-vis spectroscopy revealed a possible correlation between the electronic structure of X and solvent polarity. I would like to pursue additional characterization of X by examining their structure with UV-vis, Raman, and FTIR methods during my work this quarter. My objectives are:

- To learn and understand Raman and develop my experimental expertise in this technique
- To learn and understand FTIR and develop my experimental expertise in this technique
- To expand my understanding of UV-vis spectroscopy
- To characterize films of X prepared from aqueous, non-aqueous, and supercritical carbon dioxide using our new method and the above techniques
- To analyze my data and compare the results with my previous UV-vis findings

I propose to follow the following schedule:

Time, hours/week	Week	Planned Tasks
8	[Month] A-B	Synthesize films*
8	[Month] C-D	Run UV-vis and Raman on above films
8	[Month] E-F	Continue Raman, prepare summary of mechanism, instrumentation, and information obtained from Raman
8	[Month] G-H	Run FT-IR on above films
8	[Month] I-J	Continue FTIR, prepare summary of mechanism, instrumentation, and information obtained from FTIR
8	[Month] K-L	Analyze data and summarize results

\*Note: Synthesis may take longer or I may need to make more X films throughout the quarter. I will need to synthesize at least 2 films (preferably 3) with each method in order to assure repeatability.

[Advisor signature and date signed]

[Student signature and date signed]

available.

I find it useful to separate rules and regulations for working in the lab from the research learning contract itself. A set of guidelines that cover everything from how students get paid to how we purchase reagents and supplies is included among our group WebPages and new students are required to read and sign a copy of these guidelines before the student and I sit down to craft their research learning contract. This prevents the research learning contract from becoming filled with minutiae and from taking on a legalistic tone.

Finally, it is important to remember that research learning contracts are only a tool to help you and your student get the most out of your working relationship. They are not a substitute for working at having that relationship. Also, learning contracts are not a substitute for meaningful faculty supervision. In short, research learning contracts will not guarantee successful undergraduate research experiences — either research productivity for you or satisfactory learning outcomes for your students. That said, I have found that research learning contracts promote student learning, independence, build healthy student self-confidence, and foster meaningful student research productivity.

## Acknowledgements

I wish to thank Professor Feng Chen, Rider University, for her helpful suggestions for improving this paper, my undergraduate research mentor, Dr. Nancy Harrison Kolodny of Wellesley College, who inspired me to pursue a career in chemistry in academe, and my many undergraduate students, past and present, who continue to help me grow as an educator and scientist.

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