

Science Teaching & Learning Fellow Role and STLF-Faculty Working Arrangement

A Science Teaching & Learning Fellow (STLF) has a combined expertise in the specific departmental discipline as well as knowledge of relevant teaching methods and research on learning. A typical STLF is a recent PhD in the relevant science discipline who is keen to improve learning and interested in discipline-based education research.¹ Since most STLFs have limited prior experience with science education research, the SEI Central runs an STLF development series² on the relevant education and cognitive psychology research, research-based instructional practices, and measurement of learning. There are also ongoing meetings to further develop skills, e.g., learning-goals improvement, designing effective interactive engagement activities, conducting cognitive interviews of students, interpersonal communication and negotiation, designing and conducting rigorous assessment and research studies, and sharing experiences of what worked well (or not). The STLF role requires diplomatic skills and effective communication.

The STLFs collaborate with individual faculty or small groups to implement course transformation, helping faculty increase their knowledge of teaching and learning research and supporting the introduction of evidence-based educational practices and measurements of learning. They use a variety of methods to gather detailed data on student thinking and learning that is shared with the instructor and helps guide the course design. Course transformation is typically done over 3 terms (or a summer + 2 terms in which the transformed course is taught). Prior to the first teaching term, 3-4 months of planning takes place with considerable interaction between the STLF and faculty member(s). After the first teaching term, the course is further refined during the next term that the course is taught.

STLFs are members of their respective departments, and the departments make the hiring decisions (their appointments are typically as post-doctoral fellows or limited-term faculty). Since there is a learning curve and change takes time, an STLF appointment of at least 2 years is desirable.

STLF Role:

Below is a list of the major components of the STLF role and representative examples. Since every situation is unique, the relative emphasis on these components differs and each STLF does not necessarily do all of these activities.

Facilitate the development and/or improvement of learning goals³

- Well before the term starts, STLF meets individually with faculty member(s) to find out: What are their overall learning goals for class? What are the big ideas that the faculty are looking to get across to students? Do they have other goals (e.g. develop critical thinking, increase student interest in topics, ...)? What knowledge and skills are the students expected to have for a follow-on course (if applicable)?
- Provide relevant examples of learning goals (either from others or create them)
- Work with faculty to help them articulate learning goals in terms of what the students should be able to *do*
- Work with faculty to improve learning goals after 1st teaching term

Facilitate faculty communication and consensus building

In some courses an STLF may work with only one faculty member. In most cases, however, more than one faculty member is involved – either directly with the current or near-future teaching of the course, past teaching of the course, or teaching a follow-on course which uses and builds on knowledge and skills from the course that is under transformation. Strategies for getting group consensus on learning goals, measures of learning, etc., include:

- STLF has individual meetings with each member of the working group to find out what they feel is important and see if they have any concerns
- Facilitates group meetings; distribute materials in advance, manage meeting, write & distribute summaries
- Survey faculty to help establish areas of consensus and set priorities (e.g. ask each member of the group to rate the importance of each learning goal on a list of learning goals that emerged from the above process)

¹ STLFs have a Masters or Ph.D. in the respective science discipline. Most are recent Ph.D.'s with teaching experience.

² See: www.cwsei.ubc.ca/resources/STLF-develop.htm

³ See: www.cwsei.ubc.ca/resources/learn_goals.htm for more on learning goals and the process of developing them

Collect, distill, and communicate data to support and guide faculty efforts

- Ask the faculty member(s) whether there is any data (on student learning, attitudes, ...) that they are particularly interested in seeing. What topics or skills do the students have the most difficulty with?
- Search the discipline's education research for relevant findings
- Mine existing course data on student learning, attitudes, interest, etc.
- Probe student thinking and learning (learning of content, attitudes, interest, usefulness of different course aspects, study habits, etc.). Design studies and collect data (student interviews, observations, surveys, tests of learning, ...)
- Distill findings into concise and relevant summary and communicate to faculty and department

In collaboration with faculty:

The following is done in collaboration with the teaching team [faculty member(s) and teaching assistants (if TAs involved)]. The STLF will have a larger role in the materials development at the start of the transformation process, and gradually transition to primarily providing feedback on faculty-developed materials.

Develop curricular materials and teaching approaches (in collaboration with teaching team)

- Find out what educational challenges the faculty would like to overcome and what teaching skills they would like to develop
- STLF describes a variety of teaching approaches & ways to observe these in another course (real time or video)
- develop in-class activities that target learning goals; co-teach some of these activities⁴
- develop homework that targets learning goals
- If applicable, develop materials for recitation sessions/tutorials and labs associated with course

Develop measures of student prior knowledge (in collaboration with teaching team)

- Identify important knowledge & skills the students need—or are assumed—to have at the start of the course
- Develop diagnostic tests, homework, or other activities to measure critical knowledge and skills

Develop measures of student learning (in collaboration with teaching team)

- e.g. pre-post tests of conceptual understanding – AKA concept inventory – usually focusing on important concepts that students have difficulty with (use existing measures if available)
- Develop exam questions or other means to measure whether learning goals are being achieved

Observe classes and provide feedback

- Develop a coaching relationship with faculty member(s). Give feedback on teaching based on observations, student interviews, surveys, etc. Feedback often focused on aspects the faculty member has expressed interest in and aspects that have the greatest potential for improving learning and/or changing perspectives on teaching (e.g. suggesting ways to get students more intellectually engaged with important concepts, ...).
- Observation protocols typically used to characterize student & faculty behavior: COPUS⁵ and BERI⁶

Document and disseminate

- Create course materials package, document successes and areas that need further work
- Archive materials in the SEI Course Materials System after the 2nd teaching term
- Share experiences and research findings with local community (including other STLFs)
- Write journal articles on research findings, present at conferences & department seminars (often in collaboration with faculty members)

Serve as a resource for the department

- Consultant for general faculty questions on effective teaching and smaller projects
- Engage department by running seminars, creating newsletters, seek out ways to have informal discussions, etc.
- Keep up on relevant research

⁴ CWSEI funds are not used to pay STLFs to teach entire courses or a substantial section of a course, but co-teaching is encouraged. Department teaching funds are substituted for CWSEI funds when an STLF would like to teach a whole course (typically not more than one course per year, and dependent on availability of appropriate course and teaching funds).

⁵ Classroom Observation Protocol for Undergraduate STEM (COPUS): www.cwsei.ubc.ca/resources/COPUS.htm

⁶ Behavioral Engagement Related to Instruction (BERI) observation protocol: www.cwsei.ubc.ca/resources/Engagement.htm

STLF-Faculty Working Arrangement During Course Transformation

This is intended to be a general example of the interaction between STLFs and faculty when working on a course. Nearly every situation will have its own unique characteristics and will vary somewhat from this. In all cases it is important that the faculty members are committed to the improvement effort and feel ownership of the final product.

Who's involved: Typically 1-2 instructors (faculty members) and 1 STLF. If there are several instructors, there needs to be one who is clearly "in charge" of the course. Ideally, a working group of several other interested faculty have occasional involvement to ensure coherence with the rest of the curriculum. It is especially helpful to involve faculty who teach a follow-on course (if applicable).

How many iterations: Typically two iterations of a course to approach "full implementation"

Prior to term of change

STLF spends time collecting data on faculty member's priorities, views of other faculty about desires for course, student thinking, difficulties, successes, etc. through sitting in on classes, interviewing current and past students, observing study and help sessions. STLF and faculty member get to know each other.

Faculty:

- Determine what their personal goals, both learning and pedagogically, are for the course
- Write initial learning goals/course big ideas
- Work with STLF to create draft of pre/post assessment by discussing previous classes, exams, and homework problems. Initial assessment would have open ended questions.

STLF:

- Meet with faculty member to discuss various goals for the semester.
- Begin editing learning goals based on discussions with faculty member and working group, and past course material. Vet various iterations of learning goals by sharing with the primary faculty member(s), working group, and other STLFs in the department.

Throughout the teaching term

- Faculty and STLF meet for 1-2 hours every week to share thoughts and feedback on the course. This is in addition to any necessary e-mails to exchange material for classes. In addition, they brainstorm about what faculty can do to achieve their pedagogical goals that were expressed at the beginning of the semester.
- In order to receive feedback for changes to the course in current semester, **faculty must send existing material to STLF a minimum of 2-3 days before its use in the classroom** (further in advance is better). For topics that have been difficult in the past, suggested turnaround time is a week so that the STLF and the faculty member have time to discuss various aspects (e.g. student difficulties, relevant research, teaching approaches).
- STLF gives feedback to faculty on clarity of materials, alignment with learning goals, and identification of known or potential student learning difficulties. Develops additional teaching materials (clicker questions, in-class activities, homework, exam questions) to promote learning; reviews relevant education research; documents research justification of approach/questions/activities if possible. **STLF gives feedback and any new materials to faculty at least 1 day before use in the classroom** (further in advance is better).
- STLF attends many of the classes to provide feedback on how well the material worked, implementation of activities, and observations of student engagement and learning. It is best if the feedback is shortly after the class. STLFs also report information they have gathered on students' study habits and abilities to integrate material on their own.
- Faculty drafts assessments (e.g. homework, quizzes, exams) in collaboration with STLF. This needs to be started sufficiently early to give time for iteration between the faculty member and STLF.
- Faculty member should be willing to be flexible throughout the semester – e.g., consider adopting changes to classes at the last minute or consider major adjustment to current teaching material. STLFs need to be similarly flexible to accommodate faculty's priorities.