How to Develop Learning Goals for an Established Course: The Computer Science Model[1]

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Overview: The goal of this process is to develop a set of learning goals (also called learning outcomes) for existing computer science courses. These goals should describe, in detail, what students can be expected to do by the time they finish a course. The goals would be useful to:

- Instructors of the class – to prepare the course, focus lectures, develop exams, and have a solid, coherent story of the course.
- Students of the class – to understand more precisely the expectations of instructors, to see the bigger picture value of the materials presented, and to have a set of specific expectations that can be used to focus attention in class and studying outside of class.
- Instructors of courses which follow this one – to have an explicit description of the skills and abilities students entering the course are expected to have, to identify areas of expected knowledge that are not supported through pre-requisite coursework.

The results of the process are encapsulated in a spreadsheet with 2 worksheets. The first is a set of topic level goals (35-100 or so) that describe detailed materials at the lecture or "topic" level. The second is a course level goal grid with 3-7 higher, course level goals. Under each goal, a list of topic level goals which contribute to that course goal are listed.

General Process Outline: The model employed to develop these goals has been to have 2 (though we suspect 3-4 works as well) instructors who have recently taught the course (or are otherwise engaged with it) meet with a facilitator (STLF) for a period of 8-12 hours in either 1 hour a week or 1.5 hours every other week format. Very little outside work is needed from the instructors each week (occasionally 5-20 minutes of brainstorming or finding materials (lecture slides, exams). The facilitator spends approximately 1 hour outside of the meeting each week (on reminders to instructors, rewording materials, cleaning up LG wording, reviewing materials (exams, homeworks, etc.)). The facilitator organizes and leads the meetings, and takes all notes (documenting the brainstorming and results of the LG creation). Instructors talk and brainstorm, but do not have to take notes.

Step 1: Assessment-Driven Topic Goals: Begin by asking (before the first meeting) for recent exams given in the course. At a meeting, all faculty will sit and work through the questions on the exam developing "topic level goals" which are reflected by a correct answer on that exam question. This goes something like "if a student gets this question correct on the exam, then it shows that the student can…" Through this process we identify at least what is expected on the final. This then brings up things that are assessed on possible exams throughout the term, on homeworks, etc. It also allows for the beginnings of discussions (often about "high level" things) that we want students to get but we don't ask on the exam. This is OK, but the facilitator should feel free, to say, but if we don't ask exam questions on this, how do we know if they "got that" high level ability or not?

Step 2: Lecture-Driven Topic Goals: Since we cover many things in class that we don't necessarily assess on the final exam, we next walk through (mentally or by actual review of lecture slides) the materials covered in the course, topic by topic. Each topic is named (discussion happens about ordering, etc.) and a list of things that students should be able to do "after that material/section is covered" is named. Instructors will start by saying "we talk about this, we do that on the board", and need to be prompted with statements like "so, afterwards you would expect a student to be able to do what"? Or propose something as a possible thing students would be able to do and the instructors will say "no, more than that, like this" or "no, not that in depth, like this". Instructors may find out that they each have different expectations of depth of understanding in certain areas.

[1] This documents the process used in Computer Science, but it is certainly not the only process that can be used.

Instructors (and facilitators) will also find it common to start by saying "students will understand this and that". This is OK in the brainstorming phase. But the group should immediately (in the next few minutes of discussion) move to try to concretize "understand" by explaining exactly what would demonstrate understanding. Would that be: rank these algorithms in complexity order, compare and contrast the performance issues from disk access models, describe real world scenarios that reflect stacks versus queues, etc. Sometimes a goal listed as "understand" may get stuck there and have to be revisited at the next meeting. These are usually keys to goals that are not particularly clear or clean in the class.

This process takes the majority of the meeting times (5-7 weeks). Progress is slow in the beginning, but moves much more quickly after about the ½ way point as instructors get practiced in mentally converting what "they do" in class content into statements about what they can expect students to do after that material is covered. Instructors will get derailed when they differ in viewpoint on a topic or when a topic is difficult or perhaps doesn't fit well in a course. Instructors should be given some time to discuss issues that arise in teaching this topic (and the facilitator should document this). But after 5-7 minutes, the instructors should be reminded, "OK – I've documented our concerns here – let's go back to focusing on what we actually do right now, not what we wish we did in this case".

Depending on the level of detail and the course, we've seen 30-100 topic level goals developed usually spanning 5-15 topics. These are listed in a 2 column spreadsheet (landscape), with the topic name in the left column and the goals themselves in the right column. The goals complete a common stub of "After this class students can…". Each goal should be named something like A1, B3,... where the letter corresponds to a topic and the number to the number of goals under that topic.

Step 3: Course Level Learning Goals: After the topic level goals are done, in 1-2 meetings course level goals are developed. Often, instructors can be asked to independently brainstorm these outside of a meeting and send them in email to the facilitator. Then one meeting can be used to review these – merging similar ones, getting better wordings, etc. Occasionally, these start out too low level – basically subgroups of the topics. Through discussion, and focusing on how this course contributes to the general development of a student in the major, these can be made more high level. After identifying (a not perfect list, that may still have some duplication) of 5-12 course goals, instructors can be assigned (outside of a meeting) to place each topic goal under the column of any course goal it applies to. This can also be done in a meeting, but it can be more efficient simply to have everyone bring their grid and to discuss where people differed and if a course goal was hard to find things to fit under, or if two course goals really seemed to be interpreted as the same thing. Eventually, course goals should be pared down to approximately 4-7. Look for course goals that have few topic goals supporting them, or topic areas that fit under only one course goal.

Advice/Common Expectations: The first few weeks are marked by a lot of discussion, which may not lead directly to completed LGs. This is especially the case for problematic courses, recently designed courses, or courses where significant differences exist in coverage depending on the instructor. This is OK. Discussion among the faculty should be allowed to occur, with the facilitator bringing people back on task occasionally. The focus should remain primarily on documenting what is done *currently* rather than bemoaning what we would like the course to accomplish.

Instructors (and everyone) will tend towards high-level, grandiose statements that are very meta-level. These need to be deconstructed (especially in the beginning).

Affective goals (goals about students developing appreciation, etc.) may come up in the discussion of course level goals – though they may not be assessed on exams, homeworks, etc. Affective goals may be an important part of a course – most notably in courses for non-majors.