Educational Flow in Computing Science Courses

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Abstract

In this paper we describe the organization of a Student Research Lab (SRL, [vBvdW97]) and Student Teaching Lab (STL, [BW97]) in the context of a computing science curriculum. The SRL and STL are inspired by the following problems found in many academic computing science curriculums today: (1) the preparation for working as an IT professional is not given sufficient attention, (2) coherence within and between educational components is too weak. Our solution to these problems consists of the SRL and STL, where the flow of educational results is operationalized and formalized.

1 The overall structure

In a typical educational environment courses are offered to students by different teachers. Often a teacher is more concerned with transfer of knowledge rather than with the teaching process itself. As a result of this latter issue, students tend to behave like passive consumers. A consequence of the first issue is fragmentation of knowledge and skills.

The Student Research Lab (SRL) and Student Teaching Lab (STL) is motivated by the fact that students should not only learn computing science topics (contents), but also how to handle their knowledge and skills in a professional environment. Typical qualifications are: efficiency, effectiveness, independence, cooperation, and communication.

In figure 1 we see the structure of the curriculum at the Computing Science Department of the University of Nijmegen. In this paper we will only discuss two parts of it: the Student Research Lab and the Student Teaching Lab. The other parts will be addressed shortly. The GiP House can be seen as a student software house, in which student prepare themselves for a professional career in industry. The Student Conference prepares students for a scientific career. The PhD Research Lab is an extension of the Student Research Lab.

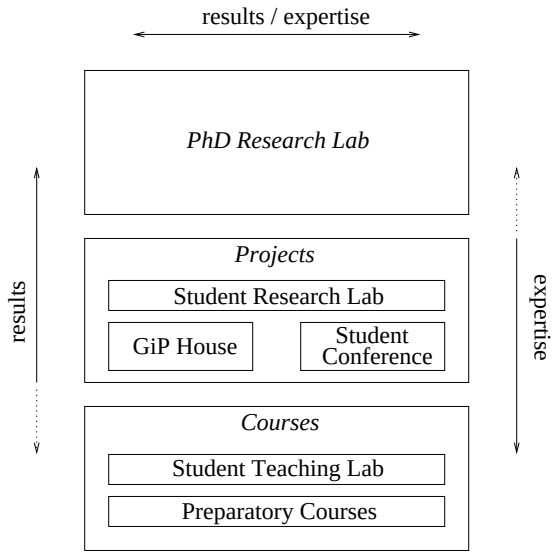

Figure 1: Flow of results and expertise

The different components in the curriculum each have their own motive. The first years are course-driven. In this phase the student activities are dependent on what teachers prescribe. The second phase is intended to prepare students to control their own activities. For this purpose, this phase in project-driven, with students having an active assignment via subprojects.

Finally, selected students get the opportunity to be more or less autonomous during the preparation of their PhD thesis.

In an ideal situation, results of early phases are used in later phases for further elaboration, while results of later phases are used to support earlier phases. The same holds for expertise gained by students. Note that these flows may also be recognized between students in the same phase.

2 Student Research/Teaching Lab

The SRL is a student research institute in which students do research and contribute to the management of the institute. Teachers operate as consultants and as a board of directors.

The SRL organizes its activities in the form of projects. A distinction is made between main projects and subsidiary projects. Main projects focus on a research activity, while subsidiary projects deal with management. A main project can be compared with a traditional Master's thesis project. The main project addresses itself to the main goals of the curriculum, dealing with technical skills. The secondary goals of a curriculum have to do with the attitude of students during their future professional carreer. Driving the SRL provides the studentsthe opportunity to show their skills with resect to the secondary goals. For example, students also do acquisition: subsidiary projects may prepare main projects for a next generation.

The typical structure of a University requires a modern organization which can be compared with the office of the future. The separate workplaces are grouped together via an intranet which is realized via the World Wide Web (WWW). The kernel of the SRL is an electronic research lab (WWW): intermediary research results (including kick-off document and planning) are available for all SRL members and for other interested people. This has a very stimulating effect.

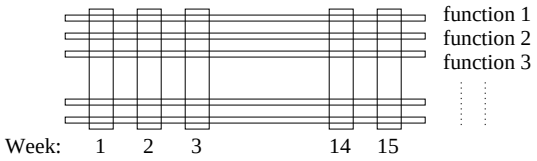

Figure 2: Horizontal versus vertical contributions

On the other hand, the aim of the STL is to increase student contributions in traditional courses. In the STL students generate and evaluate part of the course material. Different kinds of contributions are recognized here. In so-called vertical contributions (see figure 2) students present their contribution to the course at a specific point in time, say in a specific week. In horizontal contributions, students have particular functions and responsibilities during the whole semester. Clearly, there will be *different* functions and responsibilities for each student. Students write about their contributions in reports. Typical examples of STL assignments are social relevance, further research topics, and relations with other courses.

As a consequence, students yield products which can be reused. An important principle in the STL is that reuse should be aimed at as much as possible. A second principle is that since students are assigned specific responsibilities, they can play their own unique role even in the context of traditional courses.

The success of the SRL and STL is based on the concept of educational flow, where the following flows are formalized: (1) flow of knowledge and skills (which is usually the only form of educational flow), (2) flow of educational results in the form of course material generated and evaluated by students (mainly to more advanced courses), (3) flow of student expertise (mainly to less advanced courses). These flows may also be organized within a single course during the same semester or to students of the same course in a later semester. These flows are illustrated in figure 1.

3 Conclusions

The approach sketched in this paper has been used in the University of Nijmegen for a number of years. The introduction has been performed in a stepwise fashion, staying within the limits of acceptance of both students and teachers, such as to allow for a steady growing tradition. In this way teachers and students learn to appreciate the approach, and support further sprout.

Several instances of educational flow have been identified within our Information Systems courses. In figure 3 the current situation is presented. As an example, the flows *knowledge* and *prospect* are based on research results of the PhD Research Lab (e.g. [HW93], [BKM94], [BW90], [BvB96]). In addition, the flows *further research* and *assignments* are based on the results yielded by students in the Student Teaching Lab.

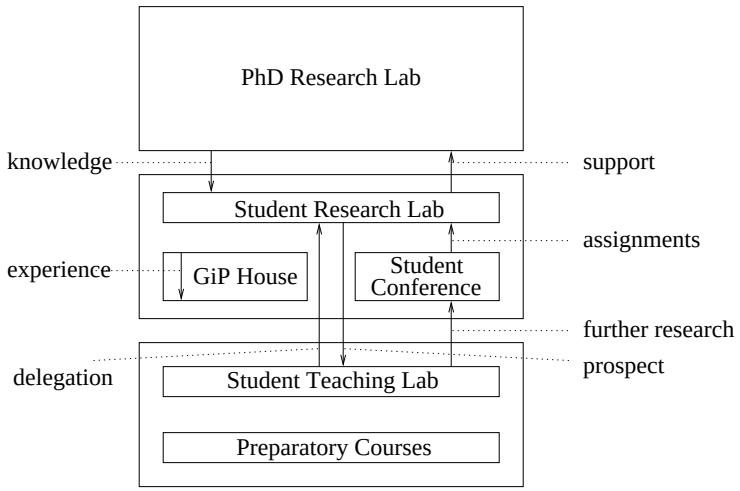

Figure 3: Flow of results and expertise

The plans for the coming years are to further refine the current structure within limits of acceptance. Here, the current enthousiasm is a key to a successful integration.

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