

THE "FOREST-LANDSCAPE-MANAGEMENT TRIANGLE" WITH ECTS AT ETH ZURICH

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Abstract

Study programmes and their regulations aim to specifically promote the acquisition of knowledge and skills by students. The design of such competence-based curricula in combination with extensive opportunities for individual specialisation requires deeper planning that combines the acquisition of competences with diverse content. We (i.e. ETH Zurich) use the relative proportions of forest, landscape and management aspects in the core courses of our major programme to observe how our students prioritize differently depending on their professional goals. By visualizing students' choice behaviour with triangular coordinates, trends can be identified early on and the skills required for the professional market can be taught in a package that is dynamic and attractive for students.

Keywords: Curriculum planning, forest landscape management, elective courses, visualisation, internship

Introduction

The Eidgenössische Technische Hochschule Zurich (ETH) introduced the Bologna system starting with all BSc programmes in 2003. At the same time, the former Departments of Forest Sciences (D-FOWI) and Environmental Sciences (D-UWNW) merged to form the new Department of Environmental Sciences (D-UWIS, D-USYS since 2012) (Gisler, 2020). The former diploma programme in Forest Engineering was replaced by a major in Forest and Landscape Management as part of the MSc programme in Environmental Sciences. As a consequence of several retirements and the discontinuation of several professorships, the new MSc programme started in 2006 with a stronger focus on research topics, emphasizing the natural sciences, landscape aspects, and more holistic management approaches at the expense of engineering sciences. All subjects are dealt with in core and optional courses.

Sparked by feedback from students and two new professors coming in, a reform of the curriculum was initiated in 2011: Larger courses (5 instead of 3 ECTS credits) should offer more time for in-depth study of the contents, the landscape aspect should be strengthened and aligned with research topics of the new professorships. The structure of the major with superordinate categories and selectable subjects should also make it possible to individually adjust the acquisition of competences to the desired career goal (e.g., forest service, nature conservation agency, landscape

management/rural planning, etc.) based on a certain diversity in content. During the revision, the core courses were reviewed for their contribution to competences and content relating to aspects in the domains of forest science, landscape science, and management, respectively (Heinimann, 2014).

In this paper, we investigated whether the desired profiling of students has occurred as a result of the revised programme. We were also interested in whether there are differences between the groups of students who choose different professional fields for their internship. Finally, it was important for us to know whether a distinct profiling can be identified among non-consecutive master's students.

Data and Methods

The 55 core courses of the 2006 (MSc06) version and the 41 courses of the 2013 (MSc13) version of the major in Forest and Landscape Management of the ETH Environmental Science Master Programme were analysed for their relative contents in the Forest, Landscape and Management (F, L, M) dimensions. All content and activities were assigned to one of the dimensions so that the contributions would always add up to 100 percent. Whenever possible, interviews with the lecturers were carried out to accurately estimate (based on Meijers *et al.*, 2005), in some cases course catalogues and other materials were used.

These estimates were then used to calculate the partial credit points which each course contributed to the three dimensions. The average weight of each dimension in the total curriculum was derived from the sum of all partial credits per dimension. Figure 1 shows the size and F, L, M proportion of all included courses together with the category from which the course can be chosen.

135 students completed their studies under MSc06 regulations between November 2008 and August 2016, 97 students did so for MSc13 between November 2014 and December 2020. Of all students, seven had a previous (BSc) degree from a foreign university, 21 from another Swiss university. For each student, the partial credits of the F, L and M dimension, respectively, were summed up over all passed courses from the core categories to calculate the individual's F : L : M ratio. While a minimum of 40 credit points (CP) had to be covered from the core courses with at least five CP from each of five categories, students could attend more courses as further electives, such that an average of 48.4 CP (MSc06) and 47.1 CP (MSc13) per student was considered in the calculations. For groups of students, the relative F, L, M values were averaged across the group without weighting for total credit points. Table 1 shows the variation in numbers of credit points across groups.

Table 1. Upper part: Credit points acquired in the F, L, M dimensions of the major core-courses, by study programme versions (MSc06, MSc13) and field in which the mandatory professional internship was conducted (waived for students with prior professional experience). Lower part: average percentages of F, L, M credit points acquired by students and offered over all major core-courses. Underlined values are different between the programme versions at the $p < 0.01$ level (t-test). For both Forest and Landscape dimensions, the values within MSc13-columns differ significantly at $p < 0.01$ (ANOVA).

Field of professional internship	Number of students		Average number of credit points acquired in F, L, M dimensions							
			Forest		Landscape		Management		Total	
	MSc06	MSc13	MSc06	MSc13	MSc06	MSc13	MSc06	MSc13	MSc06	MSc13
Applied Research	17	6	17.8	14.1	10.1	16.6	20.5	18.1	48.4	48.8
Education / Media	3	5	16.9	12.2	10.0	15.9	19.7	18.8	46.6	46.9
Industry, Services	10	1	15.0		11.6		21.3		47.9	
NGOs	25	12	17.3	12.6	11.0	13.6	21.3	17.6	49.6	43.8
Env. Offices	23	17	16.9	15.5	11.2	12.9	20.7	17.6	48.8	46.0
Public Admin	53	44	16.5	16.6	10.7	12.7	21.0	19.0	48.2	48.3
Waived	4	12	16.0	13.5	9.3	14.6	19.2	17.6	44.5	45.7
Total	135	97	16.7	15.2	10.8	13.5	20.9	18.4	48.4	47.1
Average percentage of credit points per dimension ...										
...acquired in major core-courses			34.6%	32.3%	22.1%	28.6%	43.3%	39.1%	100%	100%
...offered over all major core-courses			33.5%	30.0%	24.4%	28.5%	42.1%	41.5%	100%	100%

Triangular coordinate figures were created in MS Excel by superimposing an equilateral triangle over a standard XY-Scattergraph. For the given design where the height of the triangle corresponds to 100% of a dimension, y is calculated as $M \cdot 0.5 \cdot \text{SQRT}(3)$ and x is calculated as $y / \text{SQRT}(3) + L$

Results and Discussion

For the revised curriculum, several smaller courses (2-3 Credit Points) of the MSc06 curriculum were combined into larger courses (5 CP) and the overall course number was reduced from 55 to 41. As shown in Figure 1, three courses with a landscape component of more than 50% (lower right of graph b) were introduced. Averaged over all eligible courses, the revision led to equal weights of the forest and landscape components, while the management component remained unchanged (Table 1, bottom line).

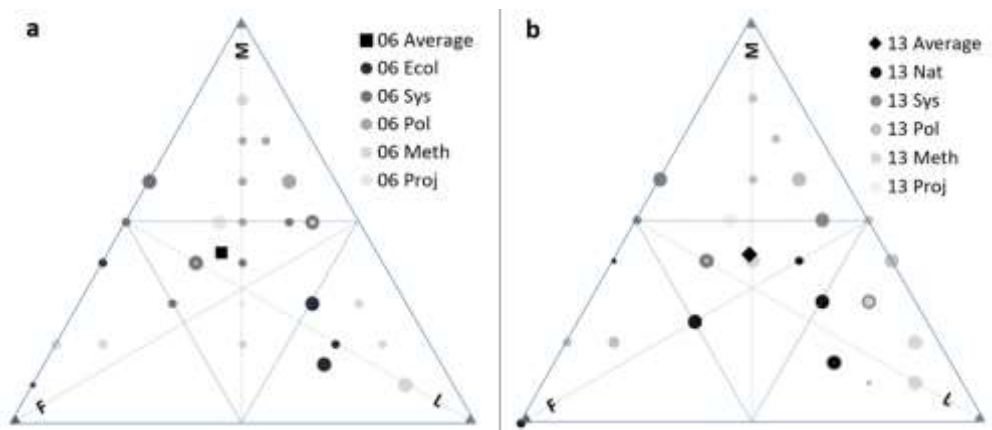


Figure 1 Relative content and overall average of the F, L, M-dimensions in the core elective courses 2006 (a) and 2013 (b) of the regulations for the Forest and Landscape major / MSc in Environmental Sciences. Grey scales indicate different course categories. Point diameters indicate number of credit points per course (5, 3, 2). A minimum of credit points in each of the 5 categories and 40 credit points in total must be acquired by the students.

Abbreviations of categories and minimum number of credit points to be acquired per category: 06 Ecol = Ecology (6), 06 Sys = Ecosystem Management (6), 06 Pol = Decision Making, Policy and Economics (6), 06 Meth = Methods and Tools of Landscape Science (6), 06 Proj = Project-related Work and Seminar (7); 13 Nat = Natural Science Foundations (5), 13 Sys = Ecosystem Management (5), 13 Pol = Decision Making, Policy and Planning (5), 13 Meth = Methods and Tools (5), 13 Proj = Interdisciplinary Project (5).

The response to the augmented landscape component was immediately visible with the first students graduating under the new regulations in 2015 (Figure 2). While choice of the landscape component increased slightly less than expected, the management component was the first to drop, with the forest component remaining at the pre-revision levels until 2018. In the last two years, however, there has been a

trend to favour landscape over forest content while the management component has remained stable.

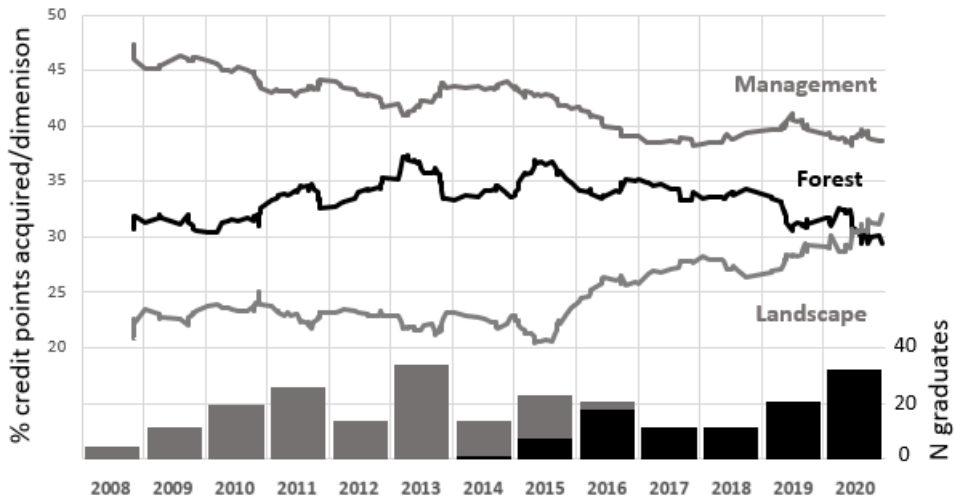


Figure 2. Individual relative content of the three dimensions F, L, M (per student and graduation date) and number of graduates per study programme version (■MSc06, ■MSc13) per year. Lines were smoothed by averaging backwards over 20 students.

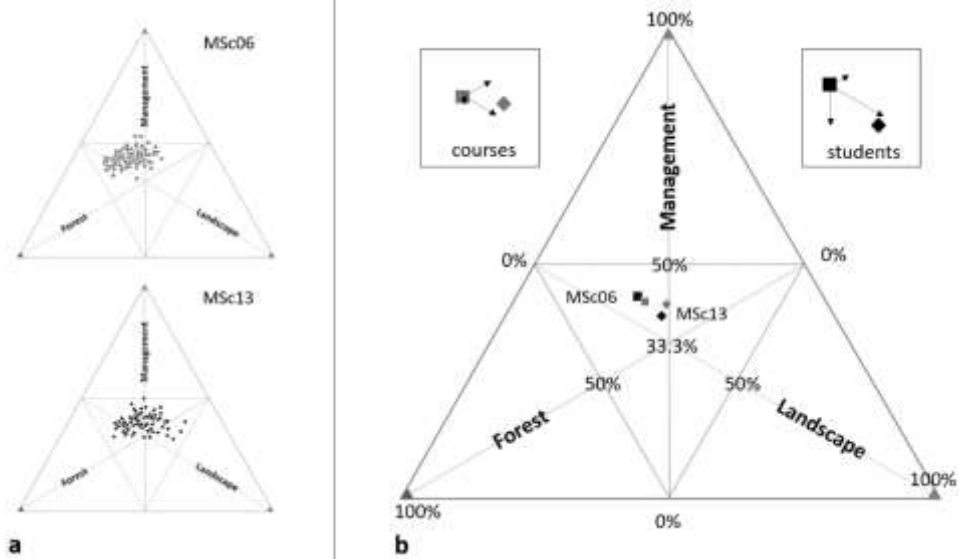


Figure 3 (a)Triangular coordinates for relative content of the three dimensions F, L, M per student graduating under MSc06 (n=135) and MSc13 regulations (n=97) (b) Average content shift from MSc06 to MSc13 in offered courses (■,◆) and students selection (■,◆) regulations. Arrows in the insets show relative sizes and directions of the shift along the three dimensions. For values cf. Table 1, two bottom lines.

Figure 3a summarizes students' individual preferences under the two regulations. The MSc06 cohort clearly favours forest over landscape components (left half of triangle) with only a few exceptions. The MSc13 cohort covers the same variation, but more individuals favour landscape over forest (right half of triangle). Additionally, several students earn more credits in the landscape than in the management dimension (triangle half below forest axis), and some earn almost half their credits in the landscape dimension (data points close to 50% line of L-axis). There is visibly more variation along the F- and L-axis than along the M-axis, where all values lie between 33% and 50%.

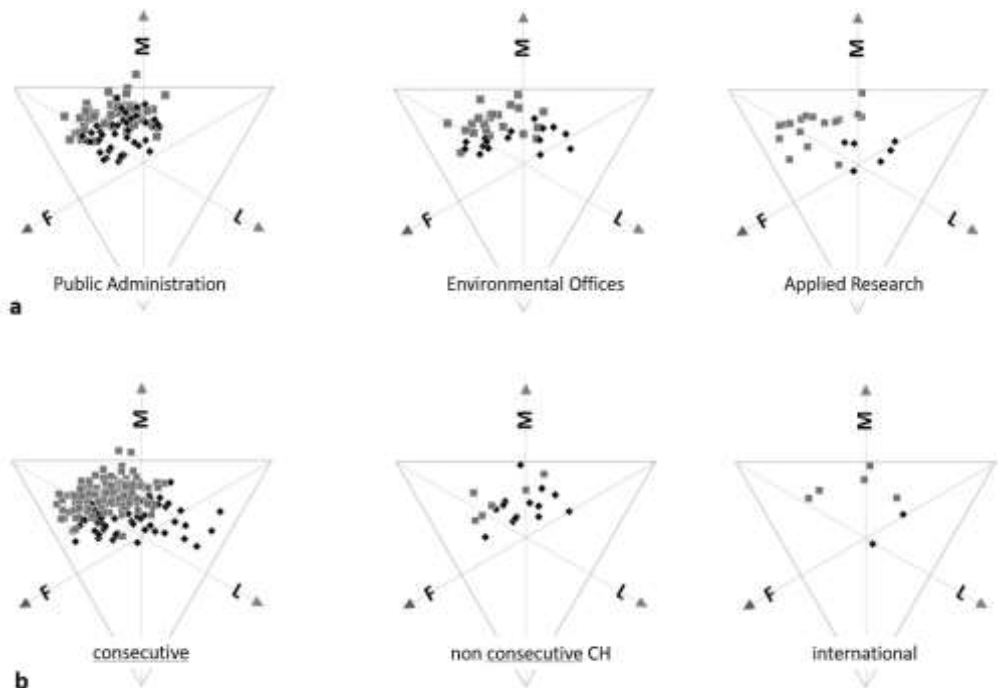


Figure 4 Triangular coordinates for F, L, M dimension per student graduating under MSc06 (■) and MSc13 (◆) regulations by a) professional area where mandatory 4-month internship was conducted and b) by place of previous degree programme. Triangle outlines from previous figures are omitted, tips of triangles correspond to the origin of the respective coordinates, triangle centre at 33.3%, side lines intersect the coordinate axes at 50%.

The triangular coordinate graphs reveal distinct advantages when comparing the study behaviour of different cohorts as illustrated in Figure 4. The student groups with professional internships in public administration show relatively little difference between the two regulations. There is a tendency towards choosing course combinations resulting in a smaller management dimension which is pronounced among students who prefer the forest over the landscape component. We believe that most of this cohort is oriented towards a career in forest administration and therefore

less interested in general landscape aspects. The choices of students seeking practical experience in private environmental offices are much more diverse and expanded along the landscape dimension. This corresponds quite well with the broad spectrum that these companies cover, e.g. from species conservation to landscape planning to resource management concepts. The number of students who seek experience in applied research has significantly decreased since the curriculum change, but it seems that the remaining group has shifted their interests away from purely forest topics to landscape-related aspects.

Comparing students with an ETH BSc degree in Environmental Science (=consecutive) with incoming MSc students (Figure 4b) shows that the “new focus” of the major programme (more landscape than management, less than one third of credits in the forest dimension) is for now almost exclusively being explored by consecutive students. The group of Swiss students from other universities is comparable to the “Environmental Office” group. While the number of international students is too small for drawing conclusions, it does not show any similarity to the group considering a classical forest administration career.

Our data suggest that the revision of the major had the intended effect of directing students toward more landscape-oriented contents and competencies while preserving a broad choice of courses which allow for various profiles. This enables them to familiarize themselves very quickly with new problem settings in a wide range of topics when they enter the professional world. With more and more of our students building up a reputation for those aspects of the curriculum, it is very likely that the profile will become even more attractive for future incoming students.

The Bologna reform has strongly contributed to the attempts to quantify study programmes in terms of both content and competences, using ECTS credits as units of measurement. With the system presented here we will continue to include a student’s elective course and internship preferences in future curricular development.

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