Strategy Paper on Course Program Science in Perspective (SiP) at ETH Zurich

The course program Science in Perspective (formerly known as compulsory elective courses) allows students of the natural and technical sciences to gain qualifications exceeding the scope of their main subject in three aspects:

- First, by acquiring *reflective knowledge* that gives them an external perspective on the subject-matter and methodology of their main subject based on cultural studies, the humanities, and social studies;
- Second, by acquiring *contextual knowledge* that places the content of natural and engineering studies as well as elements of other syllabi in a historical, psychological, or economic context or familiarizes students with the legal framework conditions of their subsequent professional work;
- Third, by acquiring *language skills* and insight into *unfamiliar cultures*, thus enhancing their employment prospects in a globalized job market.

Reflective knowledge

Perplexity resistance

The natural and technical sciences have developed historically. They are situated in a historical, moral, and political context. For instance, anyone who is familiar with the history of scientific errors, such as Becher and Stahl's phlogiston theory or Kepler's notion of universal magnetism, will bring a certain degree of perplexity resistance to the inevitable future upheavals of currently unassailable certainties. SiP courses permit ETH students to reflect deeply on the history of academia and technology as it relates to many of the main subjects taught at this institution, so as not to encounter the expected current and future intellectual revolutions in a naïve frame of mind.

The human factor

Natural and technical scientific methods such as experiments, measurements, computer simulations, etc. have long seen application not only in the sciences dealing with inanimate and animate nature, but also in the social sciences, law, and economics. As part of the course program SiP, students of ETH Zurich learn in which form the standards of concision, the scientific objective of an explanation, and prognosis can be applied in the context of the humanities.

Lectures in the Behavioral Studies Section in Psychology and Sociology have important contributions to make in this connection. For instance, it is becoming increasingly clear in the technical sciences how important it is to adapt the system of human/machine interaction to the needs, knowledge, skills, and limitations of the humans who will ultimately handle the technology (referring to usability, a concept that can be applied to a range of contexts, from consumer devices such as mobile telephones to control

functions in a nuclear power plant). To this end, the system designer must be enabled to take into account these characteristics of humans and to anticipate their behavior in handling such systems. Frequently, the personal intuition of the technical designer is not sufficient. Important basic skills and theories may be communicated by academic lectures in the behavioral sciences, for instance in the areas of psychology and sociology (cognition, decisionmaking, attitude formation, behavioral strategies). Furthermore, students may be taught specific approaches for empirical review, as early as the design stage, of how technical systems affect humans (laboratory and field research, computer simulations, behavioral modeling). Conversely, principles of success that underpin the self-organization processes in social systems may serve as blueprints for the development of socially inspired technologies, which can play an important role particularly in future information and communication technologies.

Values

On the one hand, work in the natural and technical sciences is committed to the epistemological values of truth and truthfulness, concision, and relevance, while on the other hand it is based on moral values such as utility and justice. An academic must not deceive, and engineers and mathematicians alike must be committed to precision and strive for relevant insights. Technical innovations must be useful, while their economic dissemination must not create inequalities. However, it is impossible to discuss in a deliberate manner how epistemological values are justified or the meaning of moral values and the manner of their realization without recourse to epistemology, moral philosophy, and jurisprudence. For this reason, the course program SiP offers ETH students attendance of lectures that are immediately applicable to these disciplines, for instance on the concept of truth in mathematics, problems of bioethics, or the rights to immaterial goods.

Contextual knowledge

Academic insights and technical innovations are relevant in the social, political, legal, and economic spheres. This is illustrated, for instance, by the debates on statements by climate scientists. The predicted change of the Earth's climate has social and political consequences, e.g., in terms of struggles over potable water. The transition from nuclear power to renewable sources affects entire national economies. However, these social, economic, and political implications cannot be deduced from scientific insights or functioning technology as such. Neither do the scientific insights and technological possibilities themselves provide the legal guidelines that may be required to ensure a certain way of dealing with scientific and technical innovations, such as transplantation medicine or embryonic research. Anybody who believes otherwise is naïve, and they will be bewildered and helpless in the face of the resistance and reservations that social and political systems bring to bear towards scientific insights and technological innovation. SiP-courses aim to prevent such naïveté among ETH graduates. For knowledge and technology have become crucial factors in the development of modern economies in the communities that for this reason are also referred to as "knowledge societies". It is important to understand how social and economic systems as well as political and legal institutions act, decide, and develop and how markets react to knowledge and technology if one wishes to comprehend and, even more importantly, to anticipate the effects of scientific insights and technological innovation in these contexts. Therefore, students at ETH Zurich are offered courses in the political, social, and economic sciences as part of the course program SiP that will sensitize them to these contexts, which will determine their professional work after university, and will prepare them for the attendant leadership tasks.

Furthermore, architects deal professionally with conservation and building authorities, while chemists, computer scientists, and engineers deal with patent offices. In modern societies, the law regulates more and more aspects of human interaction, including increasingly at the international level. ETH graduates working independently in a corporate environment as architects should understand building laws and spatial planning; those working as chemists, computer scientists, or engineers should acquire knowledge about intellectual property law. The professorships of jurisprudence contributing to the course program SiP supply the necessary knowledge that will assist all ETH graduates in their future professional careers.

Another example is the importance of art history for architects, which not only has historical-reflective value, but is also pragmatically relevant in dealing with conservation issues relevant to architects.

Linguistic and cultural competence

Students at ETH Zurich, an international university in Switzerland, are potentially already privileged in the area of cultural and linguistic diversity to the extent that they have studied all Swiss national languages. Nevertheless, in a globalized job market, it is important (and will become more important in the future) to have a command not only of English as the *lingua franca* of academia, but other languages as well. In particular, Oriental languages such as Arabic and Chinese are becoming increasingly important. The Language Center of the University of Zurich and ETH Zurich offers advanced courses for up to three credits in the course program SiP. Here, ETH students may either study Switzerland's national languages and English at levels beyond high school level or learn a new language from scratch. Importantly, the SiP classes of this institution also emphasize cultural and regional studies. As a complement to History of Science, students may also acquire credits in the classical languages.

General observations

This strategy is the result of a shift from the complementary general knowledge offered by the former *Freifach* at ETH Zurich to the current SiP-courses (formerly known as compulsory elective courses), which imparts reflective and contextual knowledge. During the process of this transformation, lectures in general educational knowledge with a more propaedeutic character such as art and crafts, general history, or the history of literature were replaced by studies that predominantly relate to the subject-matter and methods of the natural and technical sciences. Courses within the course program SiP can only achieve their desired effect if they are taken *during* the natural and technical science studies.

As part of the Bologna reform, the curricula of all fields of study have been revised. Frequently, lecturers have found in the course of this transformation that they would like their students to be instructed in certain additional skills or methods, but that these do not really fit into the timetable anymore. Occasionally, this has led to the wish that such courses be offered as SiP-courses. However, courses such as "How to design PowerPoint presentations", "Coding for biologists", or "Design techniques for surveys in environmental studies" do not belong in a curriculum for social or cultural studies or in the humanities.Thus, what the D-GESS offers is neither a *studium generale*, nor a complementary educational study course, nor a skills program. This view is explicitly supported by the ETH Executive Board and should be communicated to the directors of studies at other departments.