INTENDED LEARNING OUTCOMES OF SEVEN FINNISH B.SC. IN IT PROGRAMS

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ABSTRACT

Defining the intended learning outcomes is a significant part of curriculum design. Especially, the program-level competence requirements outline the objectives of the education, align the more detailed program structures and content of the curriculum, and create the basis for constructive alignment. Several different bodies aim at defining the goals of engineering programs on different levels of abstraction. Some of these documents can be considered as statements of the 'minimum threshold'. Respectively, others provide detailed guidelines to support the design of post-secondary programs in specific engineering fields. For example, the CDIO Initiative has defined a general reference syllabus aiming at creating a taxonomy of engineering learning rationalized against the norms of contemporary engineering practice. While designing new engineering programs, it is interesting to study how different universities have documented the intended learning outcomes of their programs in related domains. In this paper, the program-level learning objectives of seven Finnish B.Sc. in Information Technology programs are discussed and reflected with the CDIO Syllabus based on the information available on the public curriculum descriptions.

KEYWORDS

Curriculum Design, Competence Requirements, Information Technology, Standards: 1, 2, 11

INTRODUCTION

Focusing on the outcomes of educational experiences in curriculum design emphasizes what a learner is expected to know, understand, and be able to demonstrate after a learning process. This student-centered approach is generally applied worldwide also in the context of engineering education. In Europe, the outcomes-based approach was facilitated by the so-called Bologna Process that aimed at creating common language and transparency for higher education. (Gonzáles & Wagenaar, 2008)

The definition of the intended learning outcomes is one of the most significant parts of the curriculum design process. Especially, the program-level objectives of the education align the more detailed program structures and content of the curriculum, and create the basis for assessment. These intended learning outcomes should guide all the decisions connected to the design, implementation, and evaluation of the degree program. Besides, the program-level outcomes are often included in the general description of the program that is frequently used when presenting the program to potential applicants, students, faculty members, and different stakeholders. The intended learning outcomes provide a basis for constructive alignment (Biggs, 1996); i.e. the interplay of the teaching/learning activities and the assessment. Constructive alignment provides a framework for reflecting the fundamental questions of teaching and learning: “1) What do I want my students to learn, 2) What is the best way in my circumstances and within available resources of getting them to learn it, and 3) How can I know when or how well they have learned it?” (Biggs & Tang, 2011)

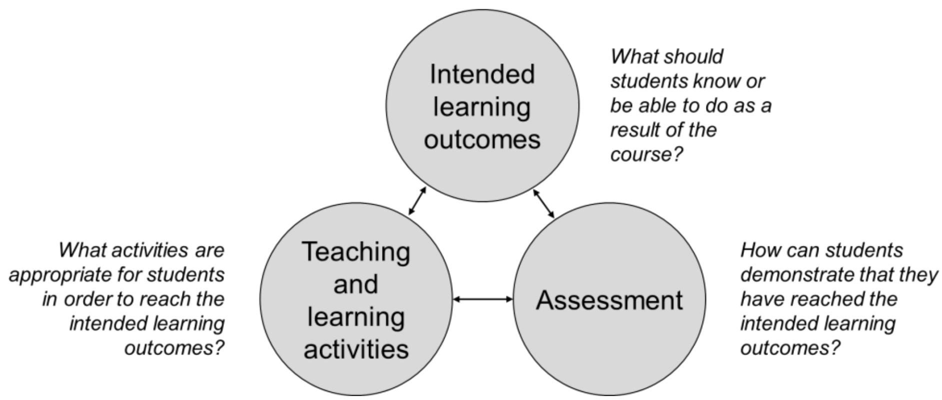

Figure 1. Constructive alignment as illustrated by Crawley et al. (2014).

Several different bodies aim at defining the overall goals of engineering programs on different levels. For example, European Network for Engineering Accreditation (ENAEE) has defined a set of outcomes that describe the knowledge, understanding, skills, and abilities that an accredited engineering degree program must enable a graduate to demonstrate (ENAEE, 2015). They are to be considered as the 'minimum threshold' to be fulfilled to assure the quality of engineering programs. These outcomes do not detail specific engineering domains but they approach the desired competencies via eight learning areas: Knowledge and understanding, Engineering Analysis, Engineering Design, Investigations, Engineering Practice, Making Judgements, Communication and Team-working, and Lifelong Learning. For example, Bachelor-level graduates should be able to demonstrate *knowledge and understanding*:

- “… of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes;
- … of engineering disciplines underlying their specialisation, at a level necessary to achieve the other programme outcomes, including some awareness at their forefront;
- as well as awareness of the wider multidisciplinary context of engineering.”

Also, the Criteria for Accrediting Engineering Programs by the Accreditation Board for Engineering and Technology (ABET) (2019) steer general curricular development globally. ABET requires that each engineering program shall have documented student outcomes that support the program’s educational objectives. The general learning outcomes have been outlined by seven learning areas that may be complemented by additional objectives articulated by the program itself. For instance, the graduate shall demonstrate “*an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics”* (ABET, 2019). In addition to the general learning outcomes, an engineering program must satisfy the specific Program Criteria that interpret the general criteria as applicable to a given discipline. According to ABET (2019), the curriculum of a Software (and similarly named) Engineering program:

> "…must provide both breadth and depth across the range of engineering and computer science topics implied by the title and objectives of the program. The curriculum must include computing fundamentals, software design and construction, requirements analysis, security, verification, and validation; software engineering processes and tools appropriate for the development of complex software systems; and discrete mathematics, probability, and statistics, with applications appropriate to software engineering."

Different disciplinary organizations provide detailed guidelines to support the design of post-secondary engineering programs. In the field of computing, the Computing Curricula of the Association for Computing Machinery (ACM) (2005) is a widely used reference model that provides detailed discipline-focused undergraduate curriculum guidelines for different subdomains of the field. The ACM documents cover undergraduate degree programs in Computer Engineering, Computer Science, Information Systems, Information Technology, and Software Engineering. The overview report provides a comprehensive overview of the field and a comparison of the expected competencies the major threads of computing programs. In short, the Software Engineers should "*be able to properly perform and manage activities at every stage of the life cycle of large-scale software systems"*. The ACM guidelines have been detailed in separate documents for each reference program. For example, the Curriculum Guidelines for Undergraduate Degree Programs in Software Engineering (ACM, 2014) describes what should constitute an undergraduate software engineering education. The learning objectives are approached via seven competence areas. That is, the graduates of an undergraduate program should be able to demonstrate *Professional Knowledge*, *Technical Knowledge*, *Teamwork*, *End-User Awareness*, *Designing Solutions in Context*, *Performing Trade-Offs*, and to show evidence on *Continuing Professional Development*.

The CDIO Initiative (www.cdio.org) has defined a general reference syllabus aiming at creating a taxonomy of engineering learning. The CDIO Standard #2 (Learning Outcomes) underlines the importance of the outcomes-based approach to ensure that students acquire the appropriate foundation for their future (CDIO, 2020). The objective of the CDIO Syllabus (Crawley et al., 2011) is to create a clear and generalizable set of goals for undergraduate engineering education to form the basis for educational and learning outcomes, the design of curricula, as well as the basis for a comprehensive system of student learning assessment. The guiding principle of the CDIO Syllabus is that engineers engineer; they build systems and products for the betterment of humanity. *"Graduating engineers should be able to conceive-design-implement-operate complex value-added engineering systems in a modern team-based environment"*. The CDIO Syllabus v2.0 is organized using four first-level competence items: *1) Disciplinary knowledge and reasoning, 2) Personal and professional skills and attributes, 3) Interpersonal skills: teamwork and communication,* and *4) Conceiving, designing, implementing, and operating systems in the enterprise, societal and environmental context*. These items are detailed further using second and third-level contents.

These guidelines aim at facilitating the design of high-quality engineering programs. They address similar themes but contain differences in their approach, level of details, and disciplinary focus. The learning outcomes linked together with purposeful learning activities and assessment are fundamental components of curriculum design. Yet, they are subject to criticism, too. For example, there is a risk that the outcome schemes become overly complex and detailed causing that they can be limiting rather than liberating guidelines (Tam, 2014).

RESEARCH QUESTION AND METHOD

Universities invest significant efforts when designing their programs and curricula to meet the mission and vision of each program leading to graduates able to demonstrate the intended learning outcomes. While planning and updating curricula, it is useful to study the different reference models and requirements available. In addition, it is an interesting question of how different universities have selected to describe their programs. This provides insight and advice on different approaches to address the task.

In this paper, the program-level learning objectives of seven Finnish B.Sc. in Information Technology (or a related domain) programs are studied based on the information available on public curriculum descriptions online. The contents of the intended learning outcome statements are reflected with the CDIO Syllabus. The intention is not to evaluate the programs or the curriculum artifacts but rather to provide an overview of how the learning outcomes have been documented in the program-level descriptions. The following seven different engineering degree programs leading to the degree of Bachelor of Science (Technology) provided by different Finnish universities were selected for this study:

- Aalto University (https://www.aalto.fi/en): Information Technology [Finnish: Automaatio- ja informaatioteknologia, Informaatioteknologia]
- LUT University (https://www.lut.fi/web/en/): Information Technology (Specialization in Software Engineering) [Finnish: Tietotekniikka, suuntautumisena ohjelmistotuotanto]
- Tampere University (https://www.tuni.fi/en): Computing and Electrical Engineering, Information Technology [Finnish: Tieto- ja sähkötekniikka, Tietotekniikka]
- University of Jyväskylä (https://www.jyu.fi/en/frontpage): Information and Software Engineering [Finnish: Tieto- ja ohjelmistotekniikka]
- University of Oulu (https://www.oulu.fi/university/): Computer Science and Engineering [Finnish: Tietotekniikka]
- University of Turku (https://www.utu.fi/en): Information and Communication Technology [Finnish: Tieto- ja viestintätekniikka]
- Åbo Akademi University (https://www.abo.fi/en/): Computer Engineering [Swedish: Datateknik; Finnish: Tietotekniikka]

Information on all these programs is available on the universities' websites. Most of the sites seem to be intended for potential applicants, yet the format and style of the sites vary significantly. Thus, this study focuses on the descriptions connected to the curricula published in study guides or similar online documents. A limitation of this approach is that there may be other documents detailing the intended learning outcomes that cannot be accessed using these references. However, studying the public curricula provides an interesting overview of the descriptions and corresponds to the visibility of university external bodies, e.g. potential applicants or collaborators who are interested in the programs.

The studied Bachelor's programs are not available in English and the respective curriculum descriptions are available only partly in English. That is, the quotations have been translated from Finnish or Swedish to English by the author and some of the nuances may have been lost in the process. Links to the original-language documents are provided but these links tend to change over time. The author has been involved in the preparation of the curriculum of the Degree Programme in Information and Software Engineering of the University of Jyväskylä.

That may have caused a bias; yet the aim has been to study all the descriptions using a similar perspective.

RESULTS

The curricula of the studied programs have been structured in different ways. Some programs are larger entities that are divided to several major subject tracks whereas others are more focused and contain less optional paths. All except one of the curricula have a general description that discusses the program's contents and the intended learning outcomes. However, the format and style of the description vary significantly. Some descriptions have separate sections focusing on the intended learning outcomes and others discuss them in more general terms. All study guides contain links to more detailed course lists including separate descriptions of each course. The course-level descriptions follow rather similar structure detailing the learning outcomes, contents, and assessment principles of each course.

An overview of the program-level descriptions of the studied degree programs is included in Appendix 1. For each program, the general structure, central parts of the content, and style of the description are presented focusing on the discussion of the program-level intended learning outcomes. In addition, the length of the descriptions/sections is indicated as the number of words in the original language to illustrate the extent of each description. Short examples of the sections containing learning outcomes descriptions are presented for each case to provide an overview of the used style of discourse.

The intended learning outcomes and other mentioned learning areas and goals were mapped to the competence areas included in the CDIO Syllabus version 2.0 (Crawley et al., 2011). As the level of detail of the program descriptions varies, the comparison was limited to the second level competence items of the CDIO Syllabus. However, the third level competence items were used to guide the mapping, i.e. to determine whether a second level competence item was covered by the description or not. In addition, the topic of Sustainable Development was included in the analysis separately. This perspective was added to reflect the presence of the topic in the texts as its importance as a part of the learning objectives of the higher education programs is widely discussed currently.

The results of the mapping are presented in Table 1. The aim was to determine if most parts of a respective competence item have been covered in the description (marked with 'X' in Table 1), only some parts of the competence item have been discussed (marked with '(X)'), or if the item seems not to be present in the description (marked with '-'). As the format and length of the descriptions were rather different from each other, this task appeared to be difficult using this limited approach. In other words, the results shall be considered only as guiding reflections of the descriptions – not as a comprehensive comparison or an attempt to evaluate their quality.

All the descriptions cover both generic engineering competencies and subject-specific intended learning outcomes. Yet, it is difficult to make a difference between the core/fundamental and advanced engineering knowledge areas mentioned separately in the CDIO Syllabus. In addition, the scientific thinking connected mainly to the competence items 2.2-2.3 is not very clearly present in most of the descriptions. One probable reason for this is that these competencies are typically considered as core contents of the Master's programs and they may be intentionally left for a minor role in these Bachelor's programs. Furthermore, communication, collaboration, and teamwork skills were mentioned in all the descriptions.

Regardless of the differences between the descriptions, some findings can be made based on the mapping. For example, the description of Aalto University discusses engineering reasoning, problem-solving skills, and the competencies of analytical thinking very widely. LUT University seems to put weight on the business context of engineering, and University of Jyväskylä highlights the societal competencies and human-oriented connections of the field of Information Technology. Tampere University emphasizes the importance of Science and Mathematics, and the University of Oulu describes the multitude of product and system areas the graduates will be able to work with, as well as touches the operating/production domain of the engineering profession, too. The description of the University of Turku contains a clear focus on the diversity of nature and sustainable development, and even links these topics to the subject-specific competencies and opportunities.

Table 1. Mapping of the learning outcome definitions of the studied program descriptions and the CDIO Syllabus 2.0 second-level competence items.

	AALTO	LUT	TUNI	JYU	UO	UTU	ÅAU*
1 Disciplinary knowledge and reasoning							
1.1. Knowledge of underlying mathematics and sciences	X	(X)	X	(X)	-	X	-
1.2 Core engineering fundamental knowledge	X	X	X	X	X	X	(X)
1.3 Advanced engineering fundamental knowledge, methods and	(X)	(X)	(X)	(X)	(X)	(X)	-
2 Personal and professional skills and attributes							
2.1 Analytic reasoning and problem solving	X	X	X	X	X	X	X
2.2 Experimentation, investigation and knowledge discovery	X	-	(X)	(X)	(X)	(X)	-
2.3 System thinking	X	(X)	(X)	(X)	(X)	(X)	(X)
2.4 Attitudes, thought and learning	X	X	X	X	X	X	-
2.5 Ethics, equity and other responsibilities	(X)	(X)	(X)	X	(X)	X	-
3 Interpersonal skills: teamwork and communication							
3.1 Teamwork	X	X	X	X	X	X	-
3.2 Communications	X	X	X	X	X	(X)	X
3.3 Communications in foreign languages	X	X	X	X	X	(X)	-
4 Conceiving, designin, implementing and operating systems in the enterprise, societal and environmental context…							
4.1 External, societal and environmental context	(X)	(X)	-	X	-	X	(X)
4.2 Enterprise and business context	(X)	X	(X)	(X)	-	(X)	(X)
4.3 Conceiving, system engineering and management	X	(X)	(X)	X	(X)	(X)	(X)
4.4 Designing	X	X	(X)	(X)	(X)	(X)	-
4.5 Implementing	(X)	X	-	(X)	(X)	-	-
4.6 Operating	-	-	-	-	(X)	-	-
>>> Sustainability-connected competences/outcomes included	(X)	-	-	X	-	X	-

* No description or learning outcome definitios included in the Study Guide (curriculum), analysis based on program homepage only.
X = The competence item has been mostly covered in the description, (X) = Parts of competence item have been mentioned,
- = The competence item has not been included

CONCLUSIONS

Despite the limitations of this study, it was interesting to study the curricula and, especially, the different ways to describe the program-level intended learning outcomes. Even though all these programs represent the same engineering domain originating from the same country and institutions regulated on a similar basis, there are significant differences in the structure, extent, and style of the ways to describe the intended learning outcomes. The pedagogical policies, instructions, and traditions of the different universities and faculties affect the way these intended learning outcomes are defined, expressed, and documented. Yet, an interesting question is how well the descriptions de facto reflect the visions, profiles, and learning cultures of each program. Do they truly affect the contents and processes embedded into the program in such a way that it makes a difference in the competencies of the graduates?

All the studied descriptions aim at defining the subject-specific competencies as well as the other intended learning outcomes that connect to both the engineering profession and the generic competencies of a university-educated individual. These outcomes contain connections to the definitions and reference guidelines published by different international bodies, too. In this study, the CDIO Syllabus (Crawley et al., 2011) was utilized as a tool to reflect the descriptions.

The study guides are typically complemented with various sources of information such as program homepages, admission guides, social media feeds, etc. This study did not cover all the available documentation available for the respective degree programs but focused on the online study guides only. Yet, it seems obvious that it is not very easy to get a detailed overview of the programs if, for example, a person unfamiliar with the disciplinary notation is seeking information to determine which of the programs to select for future studies.

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BIOGRAPHICAL INFORMATION

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APPENDIX 1 - OVERVIEW OF THE PROGRAM-LEVEL DESCRIPTIONS

Aalto University (AALTO): Information Technology

The Bachelor's degree program of the School of Electrical Engineering of the Aalto University has been organized so that the wide-range program has a general description covering the common structure and intended learning outcomes. This description is further specified separately for each of the four majors of the program. The general part of the curriculum guide (Aalto University, 2020a) contains a description of the structure of the Bachelor's program and a section entitled *Learning Objectives*. This section is followed by a notation explaining the course codes of the school. Besides, the curriculum guide contains links to the course list of the common basic studies, major study options, minor studies, thesis instructions, and guidelines on the planning of the studies. Each of the majors contains a short description of the option including the major-specific learning outcomes followed by a course list. The course lists contain a separate description of each course.

The general Bachelor-level learning outcomes (Aalto University, 2020a) are discussed describing the different knowledge and skills developed during the studies. These descriptions seem not to have been written using Bloom-style (Bloom et al., 1956) learning statements. The learning outcomes have been divided into four sections: 1) *Major and minor subject* (discussing general and subject-specific competencies developed), 2) *Engineering reasoning and working methods*, 3) *Study skills and foundation to Master-level studies*, and 4) *Working-life skills*. The description (427 words in Finnish) defines a wide range of learning objectives and contains guiding elements for students to plan their studies. The description of the Information Technology major (Aalto University, 2020b) (in total 142 words in Finnish) shortly introduces the field and adds details to the subject-specific intended learning outcomes. The style of the major-specific text seems to be a combination of generic discussion of the competencies and Bloom-style definition of the learning outcomes. Examples of the descriptions:

> General Bachelor program description; beginning of the Engineering Reasoning and Working Methods section: *"The B.Sc. (Tech.) graduate has gained competencies for the fundamentals of engineering-scientific thinking, reasoning, and working methods. During the studies, the student learns to understand the basic theories and concepts of his/her field, and to apply them in central research and development tasks connected to the field. The student constructs an overview of the professional practices of the field. The student can apply the methods of Science and Mathematics in the tasks of his/her field. … "*
>
> Major-specific description (Information Technology) example: "*The studies create a strong theoretical foundation in Mathematics and Science that is connected to the technological competences in Information Technology, Wireless Communication, and Data Networks. Application of theory to solving practical problems will be learned in experimental exercises."*

LUT University (LUT): Information Technology (Specialization in Software Engineering)

The study guide (curriculum) description (LUT University, 2020) consists of a bulleted list of the intended learning outcomes followed by basic information of the program (degree, extent, duration) and a course list. The course list contains a separate description of each course.

The list of the intended learning outcomes has been written as a numbered list that contains 11 learning statements ("*The graduate of the program is able to…*"). The statements have been written applying a taxonomy that seems to follow the principles originally presented by Bloom et al. (1956). The length of the description written in Finnish is 172 words. Two of the learning statements are directly focused on subject-specific competencies, two are mainly connected to teamwork and communication skills, two to project management skills, and two to business-oriented thinking. The other outcomes deal with systemic and holistic thinking, life-long learning, and ethical competencies. For instance, the first learning statement has been defined as follows:

> The graduate is able to *"…develop complex and scalable software applying the Software Engineering principles, tools and processes, as well as the theories and methods of Computer Science and Mathematics."*

Tampere University (TUNI): Computing and Electrical Engineering, Information Technology

The study guide (curriculum) description (University of Tampere, 2020) contains a general description that includes only one section entitled *Learning Outcomes*. In addition, the curriculum includes basic information of the program (degree, extent, campus, classifications, etc.) and a course list. The course list contains a separate description of each course.

The description of the intended learning outcomes covers the entire program including two specializations; Electrical Engineering and Information Technology. The description (157 words) also briefly explains the structure of the program. The learning outcomes are discussed in a general way covering the competencies connected to the program. That is, it seems that the learning statements have not been formulated using Bloom's taxonomy or a related model. The learning outcomes cover fundamental engineering knowledge, subject-specific knowledge areas, analytical problem-solving skills, as well as communication competencies. Also, project management skills, international competencies, and the ability for life-long learning are mentioned. For example, the core subject-specific competencies are described as follows:

> *"In addition, the graduate of the specialization in Information Technology has knowledge in the fundamentals of Programming Methods, Software Architecture, and Software Engineering."*

University of Jyväskylä (JYU): Information and Software Engineering

The study guide (curriculum) description (University of Jyväskylä, 2021) contains a short (153 words in Finnish) general description introducing the vision and mission of the program as well as the central goals, structure, and contents of the program. This description is followed by the program-level intended learning outcomes that have been written as a list of statements following the principles of a Bloom-style taxonomy. In addition to these sections, the curriculum contains basic data of the program (degree, extent, the language of instruction, etc.) and a course list that links to a separate description of each module or course.

The intended learning outcome definition contains three core learning statements describing the overall learning goals of the education. These are followed by seven additional statements that focus on the specific intended learning outcomes required to meet the overall goals. The length of the learning outcome section in total is 108 words (in Finnish). Examples of the text:

Description part: ”*…In addition to the immediate professional competencies, the degree program produces a foundation to life-long learning that is needed to develop one’s knowledge and skills during the career. The immediate professional competencies include technological contents, as well as skills to work in a multidisciplinary team to reach common objectives, communication and collaboration skills, and cultural knowledge.”*

Core learning outcome example: The graduate is able to *“…approach problems flexibly and act in situations in which the solutions are searched in the interfaces of human activities and technology.”*

Additional learning outcome examples: The graduate is able to *“…design and implement IT systems; …recognize the significance of logical reasoning and Mathematics.”*

University of Oulu (UO): Computer Science and Engineering

The study guide (curriculum) description (University of Oulu, 2020) contains a general description covering both the B.Sc. and M.Sc. phases of the Computer Science and Engineering program. The description includes 14 sections of which some contain generic content valid for both phases of the program and some are further divided into subsections for the Bachelor’s and Master’s parts separately. The description (in total 918 words in Finnish) seems to follow the structure of the Finnish national admission system data model and it covers the basic facts of the education, learning outcomes, contents, and structure of the program.

First, the description of the intended learning outcomes discusses the general focus and competence areas. Thereafter, the specific learning outcomes for the Bachelor’s and Master’s phases are presented as sets of learning sentences using a Bloom-style taxonomy. The Bachelor-level outcome definition consists of seven learning statements. Only one of these statements focuses directly on subject-specific competencies whereas three statements describe different communication and social skills. Other statements cover critical and creative thinking, teamwork, and life-long learning. The subject-specific competencies are approached as follows:

Introductory text:”*…The degree program focuses on providing pervasive skills needed in research, development, and production of IT devices, services and systems.”*

Learning outcome example: The [B.Sc.] graduate *“…understands and is able to explain the central principles, methods, and technologies of Computer Science.”*

University of Turku (UTU): Information and Communication Technology

The study guide (curriculum) description (University of Turku, 2020) contains a general introductory chapter entitled *Information on the Studies* that includes two sections: *Description* and *Learning Outcomes*. The description is accompanied by a course list that contains a separate description of each course (learning outcomes, contents + possible additional details).

The description (in total 585 words in Finnish) introduces the program goals, contents, and structure. In addition, it provides information on the learning and teaching methods, international student exchange opportunities, possibilities to select courses from other higher education institutions, and explains paths to continue to the Master’s studies. Although this description is connected to the Bachelor's degree program, the content seems to be partly written from the Master's perspective. The description section discusses also the general-level learning outcomes but they have not been formulated using Bloom's taxonomy-styled statements. The section Learning Outcomes seems to be a short (29 words) complement of the description summarizing the key learning areas. Examples from the text:

> Description section:"*…The graduating M.Sc. (Tech.) is an expert in Information and Communication Technology who has good ability to apply theory and solve problems, good communication skills, as well as readiness to develop innovative products and services in the key areas of the information society."*

> Learning outcomes section (complete text): "*In addition to the technological contents, the degree program pays attention to the development of working-life skills for the future career. Especially, the following skills and abilities are developed and strengthened: Problem-solving skills, Application of theory to praxis, Project management skills, Teamwork, and Communication skills."*

Åbo Akademi University (ÅAU): Computer Engineering

The study guide (curriculum) description (Åbo Akademi University, 2020) consists of a list of courses. The course list links to a separate description of each course (learning outcomes, contents + possible additional details). However, there is neither a general description of the program nor a list of the program-level intended learning outcomes available. Yet, the study guide seems to contain the possibility to include a program description. Most of the Bachelor's programs at ÅAU contain a short general program description and some, e.g. the B.Sc. in Economics, a longer description including a definition of the intended learning outcomes, too.

The homepage of the program contains a short section that discusses the goals and learning areas of the program (in Swedish: https://www.abo.fi/utbildningslinjer/informationsteknologi/) but no specific intended learning outcomes are defined there either. This paragraph (87 words) binds the subject knowledge to the creation of solutions for the needs of the society and business, mentions analytical problem-solving skills, as well as communication and leadership competencies. An example of the description:

> "…*During the education, you will become a skillful problem solver that is able to combine analytical, technological, and economical knowledge to find optimal solutions for society and business life.*"