education for FASHION-TECH

design and technology for future fashion creatives

Chiara Colombi, Livia Tenuta (eds)

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Digital has disrupted many industries. New values, new vision, new business models… and new actors! E4FT provides today's fashion leaders a unique opportunity to be in the driving seat for the next decades. The outcome of this European initiative express the challenge well beyond technologies: we tend to forget that innovation is not only about technology, but also about adoption. It includes social, cultural, emotional dimensions. Although these dimensions are obvious for the creation of a new product, they are usually forgotten when we start to speak about innovation. This essay express the strong connections between research, education, industry. Disruptive innovation requires new thinking, new tools, new skills, new profiles. It must be sustainable to provide return on investment. It means to create solutions, but also to educate and understand the impact, to make it last. E4FT is ambitious and pragmatic, inspiring and reliable. It's the new corner stone of an exciting and productive relation between the worlds of research and industry.

Nicolas Henchoz
Founder and Director of EPFL+ECAL LAB

This roadmap is a great resource for those involved in fashion education and more broadly for companies, policymakers and individual designers in the clothing and textile industry. It clearly highlights the environmental, social and societal urgencies and how they are intertwined and expressed within fashion. It reflects on the opportunities that technology has to offer, while also holding a critical stance towards the role and effects of the merge of fashion and technology. It provides new ways of looking at the human body and emotional needs within a rapidly changing environment that challenges design students to reevaluate the fashion system as well as individual relationships with clothing. By giving both theoretical grounding and practical guidance, it can accelerate the convergence of disciplines that is necessary in order to bring new perspectives into the fashion system and promote conscious innovation. The proposed shift in education generates a new awareness and perspective for action for a new generation of students.

Pauline van Dongen
Wearable Technology Designer,
Founder & Creative Director of Pauline van Dongen

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Chiara Colombi, Jose Teunissen

03. FASHION-TECH CURRICULUM: A NEW FRAMEWORK

C. Colombi, J. Teunissen

The Fashion-Tech Design curriculum for higher education was designed to offer the Fashion and Design Higher Education sector points of convergence, and enable a wide up-take across Europe. The educational resources developed are aimed at HEIs in the European Higher Education Areas (EHEA).

In detail three outputs were developed to contribute to the Fashion-Tech curriculum: the Tuning Document, the Learning Units and the Teacher's Toolkit. The Tuning Document aims to form a basis for education in the field of Fashion-Tech design. Furthermore, by responding to a market and industry need for hybrid professionals, the document will establish the interdisciplinary education within the field. The Teachers Toolkit aims to act as a resource for teachers with innovative teaching and learning methods and approaches. By complementing the basis for curriculum development defined by the Tuning Document, the toolkit further feeds into the development of the course modules and training units. The Learning Units aim to provide higher education teachers with guidelines for developing courses and programmes in Fashion-Tech. The purpose of the units is to provide learners with knowledge, skills and approaches specific to the 3 key areas: Design and Ideation, Technology and Engineering and Human, Social, Psychological and Economic Contexts.
The resources are presented in-depth in this chapter, and are free to use and adapt by HEIs within the EHEA, and globally.

The Tuning Document, Education4Fashion-Tech, Source: https://www.e4ft.eu

TUNING DOCUMENT: OUTLINING POINTS OF CONVERGENCE FOR MA LEVEL CURRICULA IN FASHION-TECH DESIGN

Due to the fast pace and variability of the field, and in order to tackle the issues related to fragmentation of the industry, the project and the Tuning document aims to define and establish the education and research of the field, in order to facilitate higher education institutions across the EHEA to find points of convergence and common understanding. Furthermore, the document will form a basis for the institutions to (re-)design, develop, implement, evaluate and enhance the quality of their current and planned degree programmes, that will educate and prepare professionals with interdisciplinary knowledge and skills of the area. The document follows an approach developed by the project Tuning Educational Structures in Europe, aiming to implement the Bologna Process at the institutional and subject area levels of higher education. It emphasises that universities should aim to find points of convergence and common understanding, rather than coordinating their programmes into a pre-defined set of European programmes. Thus, the Tuning Document aims to form a basis for education and research at the subject area level for a MA programme in Fashion-Tech Design, that can be utilised for designing curricula in the field. Furthermore, the TUNING Guide is utilised for guidance for formulating the Degree Profile (available in the Annex), to specify and summarise the subject area in terms of its level, distinctive features, key learning outcomes and competences. The following section defines the programme objectives, followed by the characteristics of the programme. Thereafter, the learning outcomes are defined, which are followed by generic and subject-specific competences. The next section describes how the basis can be utilised to design, re-design, evaluate or implement new or already existing programmes for education in Fashion-Tech design. Thereafter, the assessment criteria are defined, in which the learning outcomes are connected to the assessment criteria.

OBJECTIVES

The following section describes the general objectives of the programme as a second cycle education, followed by programme objectives specific to a MA programme in Fashion-Tech Design.

General Objectives

Second cycle education shall essentially build on the knowledge that students acquire in first cycle education or corresponding knowledge. Second cycle education shall involve a deep-

ening of knowledge, skills and abilities relative to first cycle education and, in addition to what applies to first cycle education, shall:
– further, develop the students' ability to independently integrate and use knowledge;
– develop the students' ability to deal with complex phenomena, issues and situations;
– develop the students' potential for professional activities that demand considerable independence or for research and development work.

Programme objectives

The two-year Fashion-Tech Design MA programme aims to develop and deepen interdisciplinary skills in the areas of Wearables, Smart textiles and Digital manufacturing for fashion. The programme is intended to create interdisciplinary figures at the intersection of fashion and technology. The new generation of professionals will be underpinned by a robust set of collaborative and transferable skills, with an emphasis on 21st-century skills, for design-driven innovation, co-creation and entrepreneurship, while being aware of the area´s impact on the society, culture and environment. More specifically, the programme objectives are:
1. to research and transfer innovation with particular reference to the innovation of materials, meanings and processes with the aim to integrate new aesthetic and functional qualities into sustainable Fashion-Tech products;
2. to codify and interpret the social and cultural practices of interaction and consumption of Fashion-Tech products to inform their design, and critically evaluate
the effects of design practices on the social, cultural, environmental and economic context;
3. to interpret the product in a systemic way or as an overall offer - composed of product lines, merchandise, different brands - and in its relations with the dimensions of communication and distribution on the market;
4. to understand the evolutionary dynamics and business models of the supply chains and organizational systems of fashion companies;
5. to plan and manage the project by integrating design processes to inform strategies for product design, distribution and communication;
6. to understand, manage and coordinate a value chain of the complex project (which operates on components, semi-finished products, aggregated processing processes, services, etc.);
7. to understand and implement business logic and strategies to evaluate market scenarios opportunities for Fashion-Tech.

Programme characteristics

The purpose of the two-year MA Fashion-Tech Design programme is to provide learners with interdisciplinary knowledge and skills in the areas of Wearables, Smart textiles and Digital manufacturing, enabled by a design-driven methodology, and informed the area´s impact on the society, culture and environment. The programme is designed with a specialist focus, where the learners will develop a broad overview as well as a deep knowledge in Fashion-Tech design, aimed to build up knowledge and experience in a special field or discipline. Successful graduates are expected to demonstrate collaborative and transferable knowledge and skills, supported by the development of competencies required for sustainable design-driven innovation, co-creation and entrepreneurship. Furthermore, as a blend of art, business, science and technology, the learners will learn to apply the design-driven methodology next to STEM skills. A further aim of the MA programme is to create hybrid professionals, with the ability to combine and manage design skills with scientific knowledge, who can be easily integrated into the professional market of Fashion-Tech. As successful graduates will be equipped for working in Fashion-Tech enterprises combining cutting-edge technologies with 'intangible' factors, they will enter the industries as agile, proactive employees, 'intrapreneurs', or entrepreneurs initiating start-ups and generating new businesses and jobs. In terms of education, the programme will allow students to obtain competences for pursuing PhD programmes in the Fashion-Tech field focusing on design, technology and management at the intersection of Wearables, Smart textiles and Digital manufacturing. The degree programme presents distinctive features, relating to its approach, structure and orientation. First, with an interdisciplinary approach, where fashion design and digital technologies are integrated, the programme responds to market and industry demand by training future professionals in interpreting trends and creating Fashion-Tech concepts, that can be further developed into aesthetic and functional products. Furthermore, blended learning, that utilises conventional and virtual teaching methods, is implemented to promote simultaneous independent and collaborative ways of working. The utilisation of Problem Based Learning (PBL) enables the facilitation of knowledge development and generation, while enhancing group collaboration and communication to transfer knowledge into practical applications. The learners will capitalise on opportunities and address

constraints of the field of Fashion-Tech design through theoretical and applied research to the concept and product development and innovation management.
Expected learners can be from a variety of backgrounds with an ambition to develop and innovate Fashion-Tech concepts, supported by an open mind-set, along with creativity and curiosity. Furthermore, the structure enables the integration of learning mobility experience in the programme, promoting internationalisation, recognition and mobility in line with Bologna Process principles, that aim to facilitate mobility within the EHEA for further studies or work, increase the attractiveness of the programme for students outside the EHEA, and to provide high-quality knowledge base leading to further development of Europe as a community.
In terms of academic content, the programmeme is intended to be divided into the following educational units, or modules: design and multimedia communication; technology and engineering; human, social, psychological and economic context; electives; individual work. The courses within the modules are to be assessed based on the achievement of the programme learning outcomes, while also integrating generic and subject-specific competencies, linked to approaches to teaching and learning and student workload.

LEARNING OUTCOMES

The intended learning outcomes have been defined based on the Swedish Higher Education Ordinance (Högskoleförordningen), as they form a generic basis that can be easily transferable to the universities in EHEA, supplemented by more specific generic and subject-specific competences.

Knowledge and understanding

For a Master's degree, a student shall independently be able to:
1. demonstrate knowledge and understanding of the field of Fashion-Tech, including both broad knowledge of the field and a considerable degree of specialised knowledge in certain areas of the field as well as insight into current relevant research and development work;
2. demonstrate specialised methodological knowledge in Fashion-Tech design enabled by a design-driven methodology, and technological insights informed by social, cultural and environmental approaches.

Skills and abilities

For a Master's degree, a student shall independently:
1. demonstrate the ability to critically and systematically integrate knowledge and analyse, assess and deal with complex phenomena, issues and situations in a variety of fields even with limited information;
2. demonstrate the ability to identify and formulate issues or problems critically, autonomously and creatively, to contribute to the formation of knowledge and solutions;
3. demonstrate the ability to plan, manage and, using appropriate methods, undertake advanced tasks within predetermined time frames, as well as the ability to evaluate this work;
4. demonstrate the ability in speech and writing, both nationally and internationally, to report and discuss conclusions and the knowledge and arguments on which they are based in dialogue with different audiences;
5. demonstrate the skills required for participation in interdisciplinary research and development work or autonomous employment in some other qualified capacity.

Judgement and approach

For a Master's degree, a student shall independently:
1.demonstrate the ability to reflect on and make assessments in Fashion-Tech design informed by relevant disciplinary, social, ethical and environmental issues, and also to demonstrate awareness of ethical and sustainability-related aspects of research and development work;
2. demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used;
3. demonstrate the ability to identify the personal need for further knowledge and take responsibility for lifelong learning.

COMPETENCES

Competences are regarded as a combination of attributes related to knowledge and its application, attitudes, skills, responsibilities and values, that describe the level or degree to which a person is capable of performing them. Those that are generic are transferable to any degree programme and must be acquired (and build upon previously obtained competences) in the first phases of the studies to prepare the learners for lifelong learning. As transferable competencies are of rising importance, the generic competences described in the next section have been defined as most relevant for Fashion-Tech design and are adapted from the transferable skills identified by the first phase of the Tuning Project and its guide to formulating degree programme profiles. The generic competences

must prepare the students for making complex judgements about their own and others' work, while the emphasis is on their understanding of the importance of their meta-cognitive skills. The competences specific to the area of Fashion-Tech design are described as subject-specific competences. The achievement of those generic and subject-specific competencies are to be accomplished within the completion of the educational units, which are described further below. The following section defines generic and subject-specific competences for the MA programme of Fashion-Tech Design.

Generic competences

1. Problem formulation and solving; capacity to identify, formulate and solve questions and problems by applying knowledge in research and practical situations, and/or in a new context.
2. Creativity and innovation; capacity to be creative in developing ideas and in pursuing research goals.
3. Planning and management; capacity to plan and manage projects taking into account time, budgetary and personnel constraints.
4. Communication skills; ability to communicate effectively by being sensitive to the needs of diverse audiences.
5.Communication of information; ability to present complex information in a concise manner orally, visually and in writing by utilising a variety of appropriate channels.
6. Teamwork; capacity for collaboration in interdisciplinary teams and for assuming responsibility for tasks.
7. Independent work; ability to work autonomously conducting original interdisciplinary research and development work in parallel to communicating concepts and critical values.
8. Critical thinking; ability to think critically in contexts of creativity, innovation, problem-solving, communication and collaboration (21-st century skills).
9. Research ability; capacity to contribute to the advancement of knowledge through scientific research.
10. Interpersonal abilities; capacity to express, reflect and demonstrate one´s awareness, determination, promotion and self-critical abilities for lifelong learning.
11. Information literacy; capacity to find, analyse, use and understand facts and concepts.

Subject-specific competences

Design and multimedia communication

1. capacity to acquire and develop knowledge and understanding of fashion design in relation to natural science, engineering, economics and management with regard to professional and/or experimental work;
2. capacity to acquire and develop knowledge and understanding of design methodology and design theory with respect to both experimental and professional work in relation to Fashion-Tech design;
3. capacity to use and reflect on the methods of composition, form principles and design expression as the basis for human-centred design;
4.mcapacity to develop original ideas and systematically apply them, transforming concepts into design solutions, to develop them into Fashion-Tech products/services;
5. capacity to function as a catalyst that enables designers to plan, manage and lead design-led interdisciplinary research and development process, and to work with scientists, computer-engineers and biologists to develop and innovate for material, products for manufacturing processes.

Technology and engineering

1. capacity to acquire and develop knowledge and understanding of textile and smart materials and their applications;
2. capacity to acquire and develop knowledge and understanding of Wearable technologies, Smart textiles and Digital manufacturing and their processes;
3. capacity to acquire and develop knowledge and understanding of the collaborative design and innovation methods to deliver more effective ways of developing user-driven innovations, disruptive products and products/services;
4. ability to research and transfer innovation with particular reference to materials, meanings and processes in various fields;
5. ability to integrate capabilities and knowledge in the engineering area and the design area (e.g. 3D virtual design and prototyping, AR/VR, HMI, coding embedded in the design process) to develop innovative products and applications;
6. capacity to evaluate diverse and disruptive forms of innovation that contribute value to a fashion enterprise and shape the future of the fashion industry;
7. capacity to creatively and critically envision future possibilities of emerging technologies and propose both new and well-explored concepts for opportunities and/or solutions in socio-cultural and economic context;
8. capacity to transfer knowledge from disciplinary fields to new sectors and applications, favouring the creative solutions of problems

Human, social, psychological and economic

contexts

1. capacity to acquire and develop knowledge and understanding of the social and economic context of Fashion-Tech design and products;
2. capacity to acquire and develop knowledge and understanding of socio-cultural and technological trends and practices to evaluate market scenarios and opportunities for Fashion-Tech products;
3. capacity to acquire and develop knowledge and understanding of new and emerging business models of the fashion industry;
4. ability to demonstrate entrepreneurial thinking that optimises opportunities, products and markets emerging from the Fashion-Tech space;
5. ability to develop communication and distribution strategies relevant to the Fashion-Tech space.

TRANSLATION INTO CURRICULUM

The allocation of credits within the programmeme is to be carried out with the top-down approach, where the whole programme consists of 120 ECTS, with 60 ECTS per year and 30 ECTS to be achieved per semester. The programme has an emphasis on a modular and flexible structure, thus the proposed credits allocated to a course unit vary from 7.5, 15 to 30 ECTS, as presented in Table 1. Furthermore, the semesters are to be divided into four terms or study periods, with possibilities of allocating ECTS per course depending on the specific purpose, learning outcomes, and teaching and learning methods of the educational unit (i.e. module). In terms of the actual length of the teaching period, one term must be allocated ten weeks, with a total of 40 weeks and 80 weeks per one and two years respectively. The proposed structure aims to ensure that each learner will achieve the intended learning outcomes during the nominal duration of the programme, while their knowledge and skills are expected to progress gradually throughout the studies and be supported by the development of competences achieved through co-curricular activities. With a total of 120 ECTS, the distribution of credits between modules is defined in a range (as shown in Table 2) to enable the learners to meet their needs based on their previous educational and vocational background and experience, and individual interests and abilities. If a different modular or non-modular structure is utilised based on the country or higher education institution requirements, it is recommended to follow the guidelines in the table regarding the percentage of ECTS that must be offered within each unit.

Name of educational unit	Number of ECTS		% of total	
	Min	Max	Min	Max
Design and multimedia communication	37.5	52.5	31%	44%
Technology and engineering	15	37.5	13%	31%
Human, social, psychological and economic contexts	7.5	15	6%	13%
Electives	7.5	15	6%	13%
Individual work	22.5	30	19%	25%

Proposed educational units, Education-4Fashion-Tech, Source: e4ft, https://www.e4ft.eu/learning-units

As the programme focus is on interdisciplinary Fashion-Tech design, the learners are expected to choose 37.5 – 52.5 ECTS within the 'Design and multimedia communication' module, and 15 – 37.5 ECTS within the 'Technology and engineering' module to enable levelled education in both design and engineering for learners with different backgrounds and experience. Furthermore, 7.5 – 15 ECTS will be acquired from the 'Human, social, psychological and economic contexts' with a focus on entrepreneurship to enable successful graduates tto comprehend changes in economic, market and sociocultural trends and develop a capacity for entrepreneurial thinking. Additional 7.5 – 15 ECTS will be acquired through the 'Electives' module to enable the learners to take additional courses based on their individual interests and abilities with the goal of developing the capacity for explaining and applying knowledge and skills critically and constructively. Lastly, 22.5 – 30 ECTS will be chosen from the 'Individual work' unit consisting of an internship for a training opportunity and/or final thesis work.

In relation to estimating student workload, one credit represents approximately 25 to 30 hours of student work time, which in total for the programme stands for 3000 to 3600 hours. As the actual learning time depends on a variety of factors, including time employed by the student and their background, the amount of student workload within modules is calculated based on the 30-hour maximum per one ECTS. Thus, the workload for one semester is intended to consist of a maximum of 900 student working hours, with 1800 hours per year. In the following sections, the educational units are described based on their purpose, subject-specific competencies, educational activities and assessment methods.

Name of educational unit	Number of ECTS		% of total	
	Min	Max	Min	Max
Design and multimedia communication	37.5	52.5	31%	44%
Technology and engineering	15	37.5	13%	31%
Human, social, psychological and economic contexts	7.5	15	6%	13%
Electives	7.5	15	6%	13%
Individual work	22.5	30	19%	25%

Proposed educational units, Education-4Fashion-Tech, Source: e4ft, https://www.e4ft.eu/learning-units

LEARNING UNITS

The following section describes the educational units in terms of their academic content, allocation of ECTS, teaching and learning approaches, along with assessment methods.

Design and multimedia communication

The purpose of the module is to provide learners with the knowledge, skills and approach within design and multimedia communication, supported by competencies developed within technology and engineering. Thus, the successful graduate will have the capacity to function as a catalyst enabling designers to work with professionals from a variety of disciplines, such as scientists, computer-engineers and biologists. Furthermore, the aim is to equip the learners with knowledge and understanding of design methodology and theory as a basis for developing original ideas and transforming them into Fashion-Tech concepts, products and services.

The module must offer a theoretical introduction and foundation to fashion design to learners with no or limited competence in the area, while also providing more advanced courses, such as ones focusing on the design-driven methodology and utilisation of 3D virtual design and prototyping. The utilisation of co-creation and peer-learning is recommended to increase learning and development of collaborative design and innovation methods. The estimated student work time must stay within the limits of 1125 and 1575 hours for 37.5 and 52.5 ECTS respectively, based on a maximum of 30 hours of work time per one ECTS. In terms of assessment, it is recommended to employ methods such as written and visual documentation of the carried out design projects through developing concepts and prototypes, which are expected to stimulate active learning to develop the subject-specific competencies within the educational unit.

Within the module, the learner is expected to develop the following competencies:

1. capacity to acquire and develop knowledge and understanding of fashion design in relation to natural science, engineering, economics and management with regard to professional and/or experimental work;
2. capacity to acquire and develop knowledge and understanding of design methodology and design theory with respect to both experimental and professional work in relation to Fashion-Tech design;
3. capacity to use and reflect on the methods of composition, form principles and design expression as the basis for human-centred de-

sign;
4. capacity to develop original ideas and systematically apply them, transforming concepts into design solutions, to develop them into Fashion-Tech products/services;
5. capacity to function as a catalyst that enables designers to plan, manage and lead design-led interdisciplinary research and development process, and to work with scientists, computer-engineers and biologists to develop and innovate for material, products for manufacturing processes.

Technology and engineering

The purpose of the module is to develop knowledge, skills and approach within technology and engineering next to design skills. For the successful graduate to work in the interdisciplinary field of Fashion-Tech design, it is important to understand and be able to apply the acquired systemic knowledge regarding materials and their application, the nature of product development and its phases and processes along with the generic and subject-specific competences. Furthermore, specific learning outcomes must relate to the areas of Wearable technologies, Smart textiles and Digital manufacturing and their processes. Courses related to Wearables must emphasise the role of technology and how it can be utilised to enhance the natural ability and performance of the human body or add new functions to the body to create interaction with other people, objects or the environment.

Regarding Wearables, the focus is on all types of fabric systems that respond to external stimuli, such as mechanical, thermal, chemical, biological, magnetic and electrical. Digital manufacturing knowledge and skills relate to an integrated approach to manufacturing where tools such as 3D virtual design and prototyping, AR, VR can be utilised while reshaping design, production, distribution and retail processes.

The module must offer a theoretical introduction and foundation to the previously described areas, followed by applying the acquired knowledge and understanding through participatory and hands-on learning approaches in the form of developing concepts and prototypes (i.e. laboratory practice, workshops, etc.). Similar to the 'Design and multimedia' module, the utilisation of co-creation and peer-learning is recommended to further develop the capacity of working in interdisciplinary teams. The estimated student work time must stay within the limits of 450 and 1125 hours for 15 and 37.5 ECTS respectively, based on a maximum of 30 hours of work time per one ECTS. In terms of assessment, it is recommended to employ methods such as written exams to test theoretical knowledge, along with written and visual documentation of the carried out design projects for developing concepts and prototypes, or of specific exercises, such as programming or developing samples. Within the module, the learner is expected to develop the following competencies:
1. capacity to acquire and develop knowledge and understanding of textile and smart materials and their applications;
2. capacity to acquire and develop knowledge and understanding of Wearable technologies, Smart textiles and Digital manufacturing and their processes;
3. capacity to acquire and develop knowledge and understanding of the collaborative design and innovation methods to deliver more effective ways of developing user-driven innovations, disruptive products and products/services;
4. ability to research and transfer innovation with particular reference to materials, meanings and processes in various fields;
5. ability to integrate capabilities and knowledge in the engineering area and the design area (e.g. 3D virtual design and prototyping, AR/VR, HMI, coding embedded in the design process) to develop innovative products and applications;
6. capacity to evaluate diverse and disruptive forms of innovation that contribute value to a fashion enterprise and shape the future of the fashion industry;
7. capacity to creatively and critically envision future possibilities of emerging technologies and propose both new and well-explored concepts for opportunities and/or solutions in socio-cultural and economic context;
8. capacity to transfer knowledge from disciplinary fields to new sectors and applications, favouring the creative solutions of problems.

Human, social, psychological and economic contexts

The purpose of the module is to develop knowledge, skills and approaches within human, social, psychological and economic contexts with a focus on entrepreneurship.

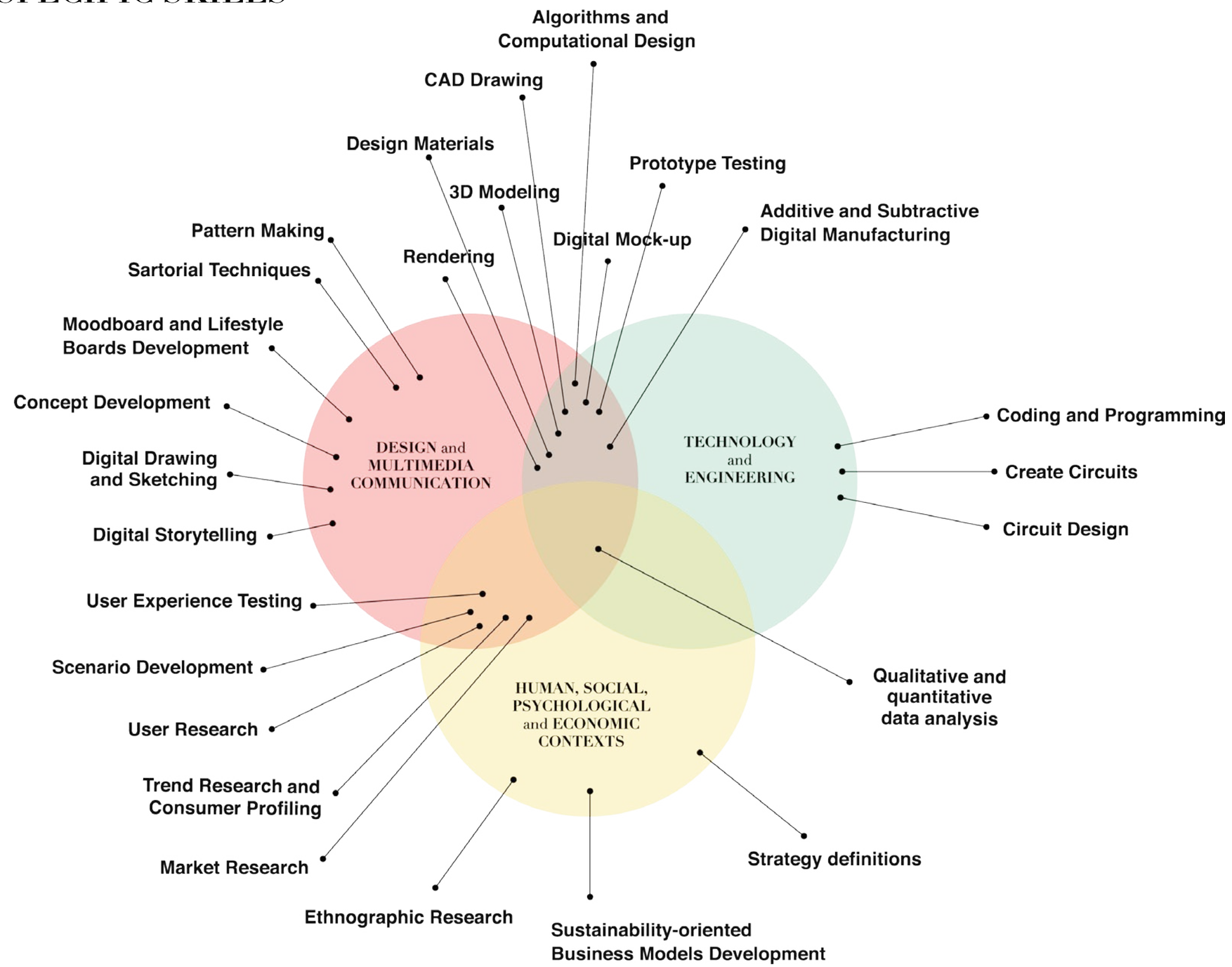
Furthermore, as the work of the future Fashion-Tech designer must be informed by social, cultural and environmental awareness, the educational unit will explore changes in consumer behaviour and interactions with Fashion-Tech, entrepreneurship and emerging business models, whilst critically evaluating ethical and sustainability issues related to Fashion-Tech products. The estimated student work time must

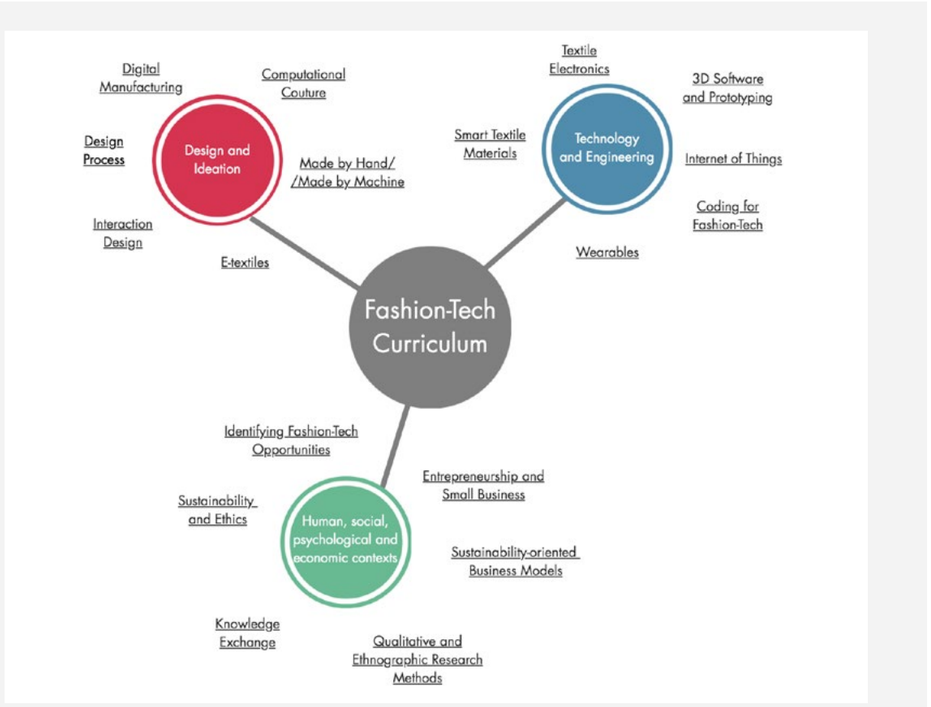
stay within the limits of 225 and 450 hours for 7.5 and 15 ECTS respectively, based on a maximum of 30 hours of work time per one ECTS. In terms of assessment, it is recommended to employ methods such as reports, oral presentations and written exams.
Within the module, the learner is expected to develop the following competencies:
1. capacity to acquire and develop knowledge and understanding of the social and economic context of Fashion-Tech design and products;
2. capacity to acquire and develop knowledge and understanding of socio-cultural and technological trends and practices to evaluate market scenarios and opportunities for Fashion-Tech products;
3. capacity to acquire and develop knowledge and understanding of new and emerging business models of the fashion industry;
4. ability to demonstrate entrepreneurial thinking that optimises opportunities, products and markets emerging from the Fashion-Tech space;
5. ability to develop communication and distribution strategies relevant to the Fashion-Tech space.

Electives
The purpose of the module is to further provide learners with the ability to explain and apply knowledge and skills in a constructive way for their professional and social needs.
Furthermore, the aim is to offer the learners additional courses in design, technology and/ or entrepreneurship to meet their needs based on their previous background and experience, and individual interests and abilities as previously described. While the expected learning outcomes and educational activities are dependent on the chosen course(s), it is recommended that the offered courses´ learning outcomes match the ones of the programme along with the activities aiming to support the interdisciplinary context of the curriculum. The estimated student work time must stay within the limits of 225 and 450 hours for 7.5 and 15 ECTS respectively, based on a maximum of 30 hours of work time per one ECTS. The acquisition of the course-specific learning outcomes is recommended to be assessed through the previously described assessment methods suitable for the particular course(s).

Individual work
The purpose of the module is to provide learners with the ability to conduct independent interdisciplinary development or research work that has scientific relevance and is informed by social, cultural and environmental approaches. Furthermore, the aim is to combine knowledge of fashion design and digital technologies with collaborative and transferable
skills through theoretical, experimental or experiential approaches for materials, design and function. The individual work must be carried out within an internship and/or (project based) thesis work. Regardless of the required course(s) within the unit, the work must demonstrate the maturity and critical skills of the graduate in the areas of Fashion-Tech design in relation to:
– deeper knowledge related to an underdeveloped topic and its potential applications, or a major contribution to the advancement of knowledge with respect to a specific research area;
– critical analysis of collected research material according to scientific principles and international standards of scientific knowledge (i.e. databases, scientific articles, conference proceedings, etc.);
– co-operation with companies or other organisations to practice the previously acquired skills in a professional setting, while additionally enabling learners to create contact with future employers or clients;
– synthesis of the outcomes to generate original, innovative and well-argued concepts, products or product-service systems combining Wearables, Smart textiles and Digital manufacturing;
– assessment and evaluation of the effects of the development work, which will be of direct value to the industry or education, along with self-reflection on the need for further knowledge.
The estimated student work time must stay within 675 and 900 hours for 22.5 and 30 ECTS respectively, based on a maximum of 30 hours of work time per one ECTS. The work carried out within an internship is to be presented and assessed through a written report and/or oral/ visual presentation. The individual thesis work is to be supported by seminars and supervision throughout the length of the course to develop and present a final exam collection for display and/or exhibition. The seminars are aimed to act as a setting for discussion between the learners and the supervisor(s) initiating critical analysis of the ongoing work. The assessment is based on the evaluation of the interdisciplinary design work, and oral and visual presentations, and self-reflection.

FASHION-TECH
SUBJECT SPECIFIC SKILLS





Learning Units, Education4Fashion-Tech
Source: https://www.e4ft.eu/learning-units

LEARNING UNITS: MIX AND MATCH SUBJECT AREAS

M. Danjoux

The Learning Units is the fourth intellectual output, that aims to provide higher education teachers with guidelines for developing courses and programmes in Fashion-Tech. The purpose of the units is to provide learners with knowledge, skills and approaches specific to the 3 key areas:

- Design and Ideation
- Technology and Engineering
- Human, Social, Psychological and Economic Contexts

The units are designed as both stand-alone and/or as intersecting learning opportunities that complement an existing programme of learning and support the development of the hybrid professional required for the Fashion-Tech industry.
There are 18 educational units divided equally into 3 contexts as listed below:

Design and Multimedia Communication

- Made by Hand, Made by Machine
- Computational Couture
- E-Textiles
- Tools for Designing
- Interaction Design: Fashion as Interface of the Body
- Digital Manufacture for Fashion: from Laser Cutting to 3D Printing
- The Design Process: Exploring and Building New Scenarios in Fashion-Tech

Technology and Engineering

- 3D Software and Prototyping
- Coding for Fashion-Tech
- Internet of Things (IoT)
- Smart textiles Materials
- Textile Electronics
- Wearables: Workshop

Human, Social, Psychological and Economic Contexts

- Identifying Fashion-Tech Opportunities
- Prototyping Future Directions in Fashion-Tech: A Knowledge Exchange Project
- Sustainability-oriented Business Models
- Qualitative and Ethnographic Research Methods
- Entrepreneurship and Small Business – Start Up Introduction
- Sustainability and Ethics

As outlined in the **Tuning Document**, the field of Fashion-Tech is characterised by the convergence of these 3 areas. Here design is defined

as including aspects related to the product, user experience and communication; technology to purely technical knowledge and skills, and economics and management to topics related to business management, supply chain management and market intelligence.
The purpose of the units is to provide learners with knowledge, skills and approaches specific to the 3 key areas:

- The design and ideation units seek to develop competences and understanding relating to design methodology and theory as a basis for developing original ideas and transforming them into Fashion-Tech concepts, products and services.
- The technology and engineering units, which are designed to offer competencies that underpin the design units, offer a theoretical introduction and foundation followed by the opportunity for learners to apply the acquired knowledge and understanding through participatory and hands-on learning approaches in the form of developing concepts and prototypes (i.e. laboratory practice, workshops, etc.).
- The units connected to human, social, psychological and economic contexts explore changes in consumer behaviour and interactions with Fashion-Tech, entrepreneurship and emerging business models, whilst critically evaluating ethical and sustainability issues related to Fashion-Tech products.

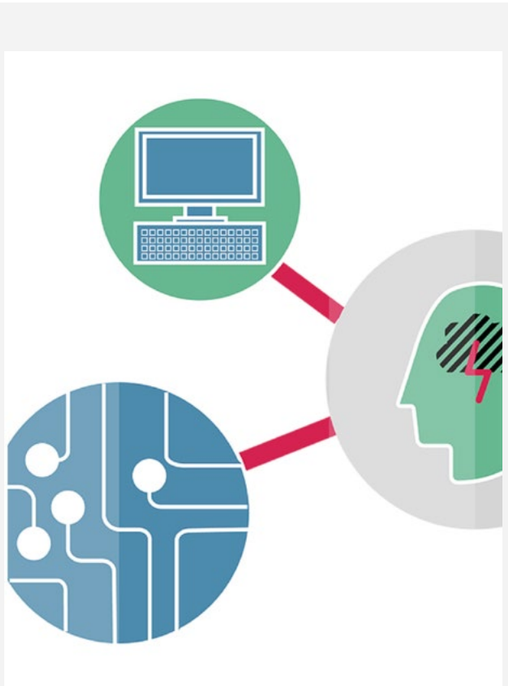
The units are designed as both stand-alone and/or as intersecting learning opportunities that complement an existing programme of learning and support the development of the hybrid professional required for the Fashion-Tech industry (see ‘Unit Mapping’). In certain instances, we also propose the units follow a certain sequencing. For example, it is envisioned that the technology units form pre-requisites for the design units, and that it would be useful to view them in this way. There are however no prescribed routes, only suggested ones (see ‘Unit Progression’).

The format of the units

Each unit descriptor consists of the following:

- Title
- Introduction
- Unit Outline
- Indicative Content and Learning and Teaching Methods
- Learning Outcomes
- Additional Tutor’s Notes*
- Assessment Methods
- Reading and Resource List

The introduction aims to provide a brief explanation of the topic of study for the unit. It is a quick way for you to gain insights into what specific aspects of learning will be addressed for the future Fashion-Tech designer.
More detailed information can then be found in the Unit Outline where the premise of the unit, its aims and the student assignment are defined together with any other important information or factors you should consider as an educator choosing to adopt the unit.
The Indicative Content and Teaching and Learning Methods section provides specific information on the type of input the unit should offer together with modes of delivery and engagement. In some instances, proposed lecture and workshop titles etc., are given and other guidance intended to assist you in running such a unit.
The Learning Outcomes for each unit explain what the student/s should be able to demonstrate on completion of the unit such as ‘in depth knowledge’, an ability to ‘critically evaluate’ etc. Some of the units have Additional Tutor’s Notes* which offer further insights into how each unit might align with others and thus form part of a larger curriculum, and direct you to pedagogic methods and resources available in the **Teacher’s Toolkit**.
The Assessment Methods and assessment criteria for these units are suggestive and flexible and you should aim to link these methods directly to the intended learning outcomes of your programme/course i.e. tailor these assessment methods to align with the knowledge, skills, and attributes that your programmeme/course of study is aiming to develop.
Finally, the Reading and Resource list provides with additional support through essential and suggested reading and a list of references that can be directed to students.



The Teacher's Toolkit, Education4Fashion-Tech, Source: e4ft, https://www.e4ft.eu/learning-units

TEACHER'S TOOLKIT: RESOURCE FOR TEACHERS WITH APPROPRIATE METHODS AND APPROACHES TO TEACHING AND LEARNING FASHION-TECH

The Teacher´s Toolkit aims to act as a resource for teachers with innovative teaching and learning methods and approaches. By complementing the basis for curriculum development defined by the Tuning Document, the toolkit further feeds into the development of the course modules and training units.

The pedagogic methods presented below, that make up the Teacher's Toolkit, have been chosen due to their relevance to teaching and learning in the interdisciplinary field of Fashion-Tech. The toolkit consists of 10 different methods and approaches, that are designed in a modular way, enabling to mix and match to create high-qualitative learning units. The tools contain a short description, a brief, a facilitator guide, and if applicable, presentations and hand-outs that can be customised. Most tools can be mixed and matched with each other, with recommendations provided under each tool.

LECTURES

The lectures provided in this tool offer four presentations:

- the definition of Fashion-Tech
- the design approach for Fashion-Tech

Toolkit, Education4Fashion-Tech, Source: https://www.e4ft.eu

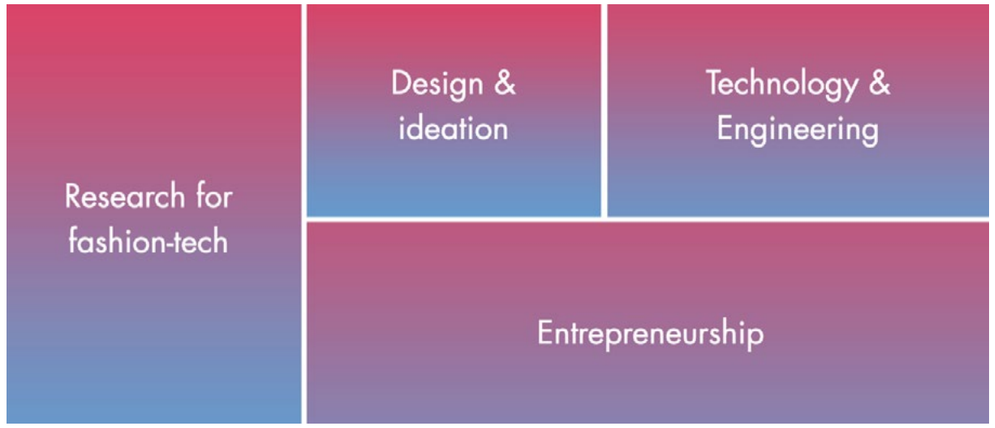
- the impact of digital technologies in the fashion supply chain
- best practice in Fashion-Tech

The lectures are recommended to be delivered to BA students or first-year MA students to provide the basics of Fashion-Tech to those with little or no background related to the field. As the lectures are developed in a modular structure, they can be used to mix and match with each other, and most other tools in the toolkit. Mix and match with work-based learning, problem-based learning and blended learning.

WORKSHOPS

Workshops prepare students for the industry and academia by encouraging students to develop transferrable soft skills, such as teamwork, communication (of information), critical thinking, and problem formulation and solving, among others. The workshops provided in the toolkit are developed in a modular way, to enable to mix and match them with each other, and other tools in the toolkit. The workshops consist of briefs, facilitator guides, hand-outs, and presentations that can be customised.

Mix and match with interdisciplinary group work, problem-based learning, learning through research and blended learning.



Toolkit, Education4Fashion-Tech, Source: https://www.e4ft.eu

INTERDISCIPLINARY GROUP WORK

The hackathon format, implemented through interdisciplinary group work, encourages students to brainstorm, pitch concepts, build teamwork skills, plan projects and develop design ideas in a fast-paced and dynamic way. The creativity, teamwork and problem solving unleashed in a short period of time through collaborative projects at hackathons often stimulate participants to engage more deeply in their professions and academic interests. These interactions serve to “open up” a classroom environment and enables an active, rather than passive, learning experience for students.

To be competitive in the emerging field of Fashion-Tech, graduates need to respond to the demands of the market with a variety of skills. The following have been identified as critical for the sector and to be developed through the hackathon activities:

• Equipping designers with collaborative design and innovation capabilities to deliver more effective ways of develop- ing disruptive products and product/services;
• Mastering co-creation and user-driven innovation processes;
• Strengthening capabilities to interpret socio-technological trends, consumer insights and narratives;
• Industrially relevant transferable skills necessary for innovation management and product development;
• Enhance creativity and innovation, critical thinking and problem-solving, communication and collaboration (21st-century skills).

Working in small interdisciplinary teams, during this hackathon students will share their existing knowledge and skills and learn from each other. Mix and match with workshops, problem-based learning, learn- ing through research, blended learning, and self-directed learning.

WORK-BASED LEARNING

Work-based learning is founded on the principle of “learning by doing” and It is a series of educational courses which integrate the school or university curriculum with the workplace to create a different learning paradigm.

Work-based learning strategies include the

following:
• Apprenticeship or internship involving the student working for an employer where he or she is taught and supervised by an experienced employee of the chosen organisation;
• Job Shadowing introducing the student to a particular job or career by pairing the student with an employee of the workplace;
• Field trips offering the students an insight into the latest technological advancements and business strategies of an enterprise;
• Entrepreneurial experience including setting up of specific business, right from the planning, organising and managing stage to the risk control and management aspects of a business;
• Cooperative education in which the work experience is planned in conjunction with the technical classroom instruction;
• School-based enterprise as a simulated or actual business run by the school.

The advantage of teaching through workshops made in cooperation with companies is useful to allow students to make prototypes, practically test the design assumptions and combine manual experimentation with the most advanced modelling technologies. Mix and match with workshops, field trips, learning through research and self-directed learning.

PROBLEM-BASED LEARNING
Problem-based learning (PBL) is a student-centred, rather than instructor-centred, teaching method with the origin in the medical field. The teaching strategy has gained wide acknowledgement outside medicine as the students gain practical experience applying their content knowledge to solve real-world challenges in the safe environment of the classroom. PBL is a good fit for Fashion-Tech since the methodology is very practical. When utilising PBL, students are mostly faced with a problem that practitioners in their industry are confronted with on their regular workplace settings. Students should then locate suitable information and resources for solving the problem. The teacher has an advisory role throughout the process. It is the students' responsibility to choose the best solution, present findings and support for their teamwork. It is often stressed that apparel designers of the future must be strong team members, communicators, and problem solvers — all skills that are enhanced by the PBL teaching method. Mix and match with most other tools, for example, lectures, workshops, and interdisciplinary group work.

FIELD TRIPS
Field trips are organised by teachers identifying local Fashion-Tech resources useful for student's learning. Field trips offer the students an insight into the latest technological advancements and business strategies of an enterprise. Students also gain awareness of the various career opportunities available and understand the driving forces of the community's economy. The purpose of the trip is usually observation for education, non-experimental research or to provide students with experiences outside their everyday activities.
Field trips are most often done in 3 steps:

• Preparation applies to both the student and the teacher. Teachers often take the time to learn about the destination and the subject before the trip;
• Activities that happen on the field trips often include lectures, tours, worksheets, videos and practical demonstrations;
• Follow-up activities are generally discussions that occur once the field trip is completed.

Mix and match with research-focused workshop, work-based learning and learning through research.

LEARNING THROUGH RESEARCH
The roles of research and innovation, which are considered to be the driving forces in our world economy, are continuing to increase. Therefore, it is important for students to receive the opportunity during their studies to participate in research and faculty-guided projects. As probably the best careers in the future will likely require strong research skills, students within Fashion-Tech design will benefit from opportunities that enable to apply their knowledge in respective research projects. The students might work on research projects in collaboration with a faculty member, a research centre, or on a project sponsored and funded by an industry stakeholder. Depending on their interests, they are encouraged to work on an academic paper; market research project; scientific experiment or engineering project. It also provides opportunities for students to be a part of applied research in a corporate or industrial setting.
Mix and match with research-focused workshop, work-based learning, field trips, and self-directed learning.

BLENDED LEARNING

Blended learning is an approach where conventional teaching and learning practices are integrated with those online, where the student has some control over time, place, path and/or pace. According to the International Association of Blended Learning, the approach is defined: “Blended learning is an educational approach, which integrates face-to-face classroom practices with online and mobile delivery methods. It aims to provide the learner with a well-planned, managed, and well-structured teacher-facilitated interactive learning environment, where high-quality content, activities, and experiences can be customised to learner needs and preferences, unrestricted by time and location.” Thus, key rules for implementing blended learning are: (1) the integration of face-to-face and online learning approaches; (2) optimising student engagement through rethinking the course design; and (3) restructuring and placing traditional class-room hours. This allows for enhancement of the properties and possibilities of each to create a unique combination of different modes of communication for a purposeful, open and disciplined community. Mix and match with all other tools in the toolkit, to facilitate and enhance student learning by incorporating technology.

SELF-DIRECT LEARNING

Learning independently can be challenging, even for the most motivated students. There are understood to be four key stages to independent learning, known as self-directed learning: being ready to learn, setting learning goals and time management, engaging in the learning process, and evaluating learning. In relation to the Fashion-Tech field, an ability to self-direct and self-evaluate is critical. The Fashion-Tech sector requires graduates to be capable of planning and research, to creatively problem solve and innovate solutions with entrepreneurial mindsets. Self-directed learning promotes the development of self-confidence, initiative and perseverance. Both independence and the ability to collaborate in interdisciplinary teams are necessary skills in Fashion-Tech, as such self-directed projects can be conducted by students individually or as part of a group. Mix and match with work-based learning, problem-based learning, learning through research and blended learning.

RESOURCES

The last tool in the toolkit provides teachers with relevant terms that have been used in the project, to provide points of convergence and common understanding to those in the European Higher Education Area (EHEA). Furthermore, a bibliography has been developed (2019), to provide teachers and students with relevant resources (such as reading materials and videos) related to e.g. fashion theory, mixed reality, sustainability, etc.

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