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Education for Sustainable Development through Design Thinking

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Abstract. The article pleads for Education for Sustainable Development (ESD) in the textile and fashion sector and shows possibilities how this can be implemented from elementary school to higher education and vocational training. It begins by highlighting the non-sustainable practices and deficits that can be found in the fashion and textile sector worldwide and explains the sustainability goals in the context of the UN Roadmap ESD for 2030. In order to raise the awareness for sustainability and implement these goals, education is needed. The article introduces the concept of ESD as a guiding principle with the core element design competence, implemented by the interdisciplinary method of Design Thinking (DT). In order to successfully teach the ESD-relevant design competence, various didactic principles are required. It can be shown that they are very similar to the principles and phases of DT. Within a research project DT and its potential for implementing ESD has been investigated in teaching-learning situations at elementary schools as well as in an interdisciplinary seminar for student teachers. These findings have been transferred to the EU project Fashion DIET, which pursues the goal of implementing ESD in the textile and fashion sector. By means of an online pilot workshop, the methods and principles of DT were presented and explained to lecturers, teachers and educators, who gave their feedback on the potential of DT as a method to implement ESD as a guiding principle in their curricula.

INTRODUCTION

Need for Sustainable Action in the Textile Sector

The global fashion and textile industry have been in a continuous process of transformation for years, driven by global competition. According to a McKinsey report [1], clothing production doubled from 2000 to 2014, reaching 100 billion for the first time in 2014, which is approximately 14 garments per global citizen [1]. The reasons for this development are anticipated to be population growth, growing prosperity in newly industrialised countries and the accompanying increase in demand. In Germany, clothing is the non-food consumer goods segment with the highest turnover [2] with new trends being developed in increasingly shorter cycles and, accordingly, new clothing being produced more quickly. This development in the fashion industry, which has decisively revolutionised the entire sector, is known as fast fashion [3]. The term describes the phenomenon of consumption having increased while the product life cycle of textiles and clothing has shortened significantly. Consumption has increased while the product life cycle of textiles and clothing has shortened significantly. In Europe, almost 26 kg of textiles are purchased annually per person and approximately 11 kg are disposed of [4]. This development leads to serious environmental damages as well as social injustice in the producing countries.

These sustainability issues affect industrialised, developing and newly industrialised countries, which have to reconcile their responsibility in the areas of social standards, environmental and climate protection with the pursuit of economic growth. The textile and fashion industry are not exempt from this; a change of mindset is required on the part of all actors in the textile value chain and consumers. The manner in which textiles and clothing are produced, used and disposed requires a transition from a linear to a circular system [5]. Circular textile economies not only

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require new business models that promote these changes and develop appropriate systems in manufacturing, retail, services, reuse and recycling [6], but also sustainability educated and collaborative consumers.

Concept of ESD

The campaign Education for Sustainable Development (ESD) emerged from the UN decade by the same name, which was proclaimed by the United Nations for the years 2005 to 2014. The global vision underlying the decade was to provide all people worldwide with educational opportunities that enable them to acquire the values and knowledge, as well as the behaviours and lifestyles necessary for positive social change and a future worth living [8]. ESD is an educational mandate with the aim of anchoring sustainable development as a guiding principle in all areas of education, so that global problems such as overexploitation of nature, climate change or poverty could be solved [8, 9]. According to the BMBF [9], development is generally considered sustainable when people worldwide, present and future, can live with dignity and develop their needs and talents while respecting planetary boundaries [9]. Such a societal change requires not only powerful institutions but also technologies, knowledge, participatory conflict resolution as well as decisions and new patterns of behaviour. With the future vision of shaping a sustainable and peaceful society, the United Nations adopted the global sustainability agenda known as Agenda 30 in 2015. A total of 17 sustainability goals specify the areas in which sustainable development must be anchored and strengthened by 2030. Education is indispensable for achieving the 17 goals. High-quality education goes beyond mere factual knowledge and should enable all participants to develop skills such as *autonomous action, participation in social decision-making processes, forward thinking* as well as *interdisciplinary knowledge* [9].

The concept of ESD thus describes a transformative and holistic educational approach that considers both learning content and outcomes as well as the learning environment and pedagogy. Teaching and learning should be designed interactively to enable *action-oriented*, *transformative* and *explorative learning*. It is not only about sustainability issues such as biodiversity or climate protection, but about developing a global view that enables people to be responsible citizens, starting with everyday decisions. Consequently, ESD affects all people and is a continuous process that contributes to the acceptance of processes involving social change. ESD is a cross-sectional task, has an integrating function and aims to improve people's living environment. Furthermore, ESD creates individual, social and economic opportunities for the future and promotes global responsibility. In the school context, the aim of ESD is that pupils acquire competences about sustainable development. Competences are generally understood as the cognitive abilities and skills available to or learnable by individuals to solve specific problems, as well as the associated motivational, volitional and social dispositions and skills to use solutions successfully and responsibly in variable situations [10]. ESD is particularly concerned with the following major concerns: readiness to engage and take responsibility, dealing with risks and uncertainty, empathy for other people's living situations and sound judgement on future issues [11]. In this context, ESD serves in particular to gain basic knowledge for tackling key societal problems and design competence [12]. This coincides with Petruschat who regards design as a formative activity which is able to intervene in ecological contexts [13].

DESIGN COMPETENCE AS THE CORE ELEMENT OF ESD AND DESIGN THINKING AS AN ENABLER

In Germany the promotion of design competence is part of the overarching educational goal of the Orientierungsrahmen für den Lernbereich der globalen Entwicklung [Orientation Framework for Global Development Learning], which was commissioned by the Bundesministerium für wirtschaftliche Zusammenarbeit (BMZ) [Federal Ministry for Economic Cooperation and Development] and the Kultusministerkonferenz (KMK) [Conference of Ministers of Education]. According to de Haan, design competence is the core competence of ESD [14, 15, 16]. It refers to the ability to apply knowledge about sustainable development and to recognise problems of non-sustainable development. This means being able to draw conclusions about *ecological, economic and social developments* in their interdependence from analyses of the present and studies of the future. Furthermore, it also includes being able to make, understand and individually, collectively and politically implement decisions based on these conclusions, with which sustainable development processes can be realised [17]. Combining economic prosperity with socially just conditions, while minimising environmental pollution, conserving natural resources, and not imposing burdens on future generations that would impair their life chances compared with today's, has become the objective of both international and national policy [14]. De Haan's target dimension of sustainability is in accordance with IDEO's

definition of innovation. IDEO is a US design agency which at the beginning of the millennium pushed for innovation, especially in technology-related areas by means of DT. Accordingly DT brings together what is desirable from a human point of view with what is technologically feasible and economically viable in order to create user-centred innovation: “Thinking like a designer can transform the way organizations develop products, services, processes, and strategy. It also allows people who aren’t trained as designers to use creative tools to address a vast range of challenges” [18].

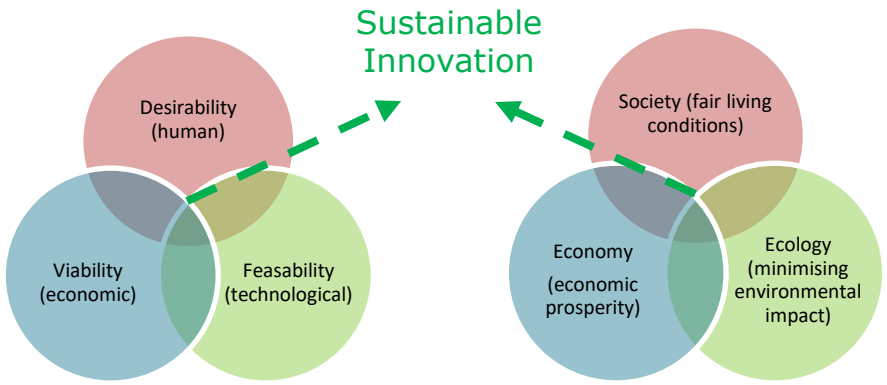

FIGURE 1. Synthesis between the “Model of Innovation”, own illustration.

According to IDEO and HPI School of Design Thinking, which further developed the DT methods of IDEO at the Hasso Plattner Institute (HPI) of the University of Potsdam, Germany, DT is a systematic approach to complex problems from all areas of life – also including ESD. The approach goes far beyond the classic design disciplines such as shape, layout and industrial design. In contrast to many approaches in science and engineering practice, DT addresses a task from the technical feasibility, or economic viability [20]. User requirements and needs as well as user-oriented inventions are at the centre of the process. Designers look at challenges through the user’s glasses and thus put themselves into the role of the user [20]. DT involves an iterative process with the six phases: *Understand, Observe, Point of View, Ideate, Prototype, and Test*, to be seen in figure 2 (own illustration, adapted from HPI Academy).

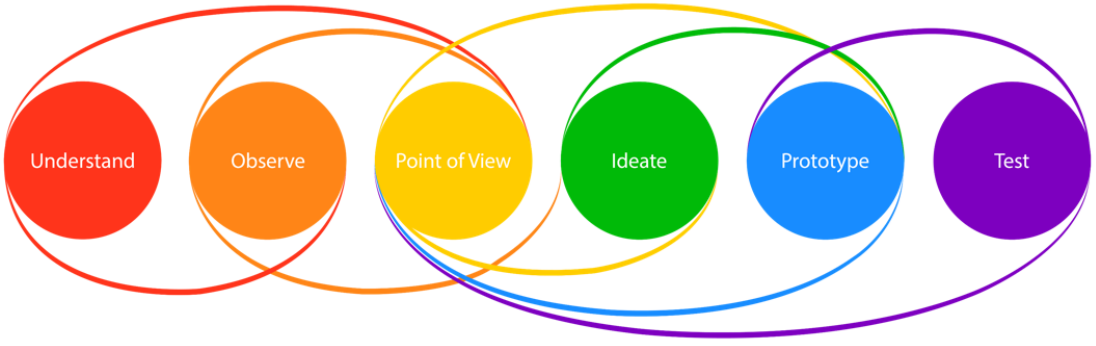

FIGURE 2. The six phases of the iterative DT process by HPI School of Design Thinking

The standstill in the area of technological and user-centred innovations at the beginning of the millennium [21, 22] can roughly be compared to the one that currently makes it difficult – but at the same time urgently requires – to implement an orientation towards sustainability in the textile and fashion sector [4, 6]. This leads to the assumption that DT has high potential to implement ESD in this industrial sector. According to international surveys conducted

in about 250 companies, which have integrated DT in their corporate culture, 71% of respondents said that DT improved their way of collaboration, 69% felt that the innovation process was more efficient and that customer needs were considered [23]. In order to implement DT in textile and fashion companies as well as in textile education it is important to internalise its principles as a mindset [21, 22]. The principles of DT are as follows:

1. Interdisciplinary Cooperation
2. Embrace Failure
3. Embrace Experimentation
4. Build on the Ideas of Others
5. Defer Judgement
6. Focus in Human Values
7. Empathy
8. Culture of Prototyping
9. Craft Clarity
10. Show Don't Tell
11. Bias Toward Action
12. Radical Collaboration

The principles 7. to 12. have been investigated in a research project about creative confidence in educational settings [24]. As one of the results it can be stated that these principles lead to more creative confidence in educators and trainers. Creative confidence is a key to realise design competence. When teachers have confidence in their own creative competence, they are able to foster creativity and design skills in their students [24]. In this context it is promising to see that de Haan describes 12 sub-competences of design competence which he considers necessary for implementing ESD [19], to be seen in figure 3 (own illustration). These sub-competences have a high similarity to the DT principles described above [21, 22]. The DT principles and sub-competences of design competence for ESD are also reflected in the expanded design concept [25, 26]. Accordingly, the design process can be understood as a problem-solving method that is potentially transferable and applicable to all living conditions [25]. Areas such as education, economy, politics and challenges of social coexistence thus also move into the field of consideration [26]. This view thus also implies solutions for a sustainable development. In summary, it can be stated that ESD *offers* and at the same time *demands* design competence.

FIGURE 3. Sub-competences of design competence described by de Haan

DESIGN COMPETENCE IN LEARNING CONTEXTS

In order to teach design competences at a young age, the educational researchers Künzli and Bertschy [27] have explored different didactic principles at elementary school level. They describe and differentiate between general and specific didactic principles which are key for ESD [27].

General Didactic Principles

General didactic principles include all those didactic principles that play a central role in many subject areas and educational concerns and therefore are also important for the implementation of ESD in education, they are *Research-based Learning, Orientation Towards Action and Reflection, Accessibility and Combination of Formal and Material Learning* [27]. *Research-based Learning*, for example, enables an active learning process, adds a self-directing and constructivist component to it, enables the learners to work independently and actively and to participate in overarching projects by (co-)designing, experiencing and reflecting [28]. This coincides with the DT principle *Embrace Experimentation* [21, 22]. Künzli and Bertschy are of the opinion that in this case it is important to reflect on the preparation in groups and plea for its implementation in combination with the didactic principle *Orientation towards Action and Reflection* [27], which coincides with the DT principle *Bias Towards Action* [21, 22].

Specific Didactic Principles

Specific didactic principles include all those principles that are characteristic for ESD, they are named as *Orientation Towards a Vision, Networked Learning, Orientation towards Participation*.

Applying the principle *Orientation Towards a Vision*, the planning and implementation of lessons in ESD should be oriented towards the design of a desired future or a vision [29]. Learners should deal with topic-specific visions and the focus should not be on problems and their solutions, but primarily on visions and their achievability [29]. The visions serve both as a planning tool, which helps to determine the contents and the course of the lesson, as well as an orientational variable for decisions in the lessons themselves [27]. This coincides with the development of creative confidence by DT [24].

Applying the specific didactic principle *Networked Learning* means that learning must take place in a perspective-based manner, in which different perspectives and aspects on a topic or issue should be facilitated in the classroom [27]. The focus on interconnectedness in the classroom leads to the consideration of consequences and side-effects of decisions and the evaluation of alternatives. Learners should generally be aware of their own perspective on a (complex) topic and should also be confronted with diverse perspectives [27]. This principle coincides with the DT principles *Interdisciplinary Cooperation*, where the different views of interdisciplinary teams lead to more solutions of a challenge or a problem and *Build on the Ideas of Others*. This means that there is no one right solution, but rather that the solution finding is based on the fact that many different ideas complement each other and can lead to a much more differentiated solution in a brainstorming session [21, 22].

The didactic principle *Orientation towards Participation* is applied on two levels: on the one hand, to each individual learner as the addressee and, on the other hand, to the class as a whole [29]. Participation includes both taking part in and influencing decisions, as well as sharing the consequences of these decisions. It also implies the exchange of information and interaction amongst the children involved. The aim is to perceive children as individuals with their own talents, convictions and experiences and to enable them to deal with their environment independently and actively through their individual prerequisites and thus to reach new insights [29]. This coincides with the DT principles *Bias Towards Action*, which assumes that new ideas arise in the course of action and doing, and not by sitting at a desk and just thinking [21, 22], and to *Radical Collaboration*, that sees individuality as a great potential, which leads to more creative solutions, especially in collaboration [21, 22].

To a large extent, these general as well as specific didactical principles also apply to adult and continuing education. In qualitative interviews as part of a research project on participant orientation [30, 31], participants in two different adult education programs indicated the following: Learning contents of further education should relate to their daily work and be directly applicable, learning content should be taught more by means of practical exercises and less by theory, participants prefer to be asked in advance about their requirements in order to decide whether to take part in a training program [30, 31].

ESD THROUGH DT IN EDUCATIONAL SETTINGS FROM PRIMARY TO HIGHER AND FURTHER EDUCATION

DT as a teaching method in primary education investigated in a research project

A research project, carried out at the University of Education Freiburg in cooperation with Reutlingen University, investigates the impact of Design Thinking (DT) in elementary school settings. The research question is about the opportunities to foster creativity, problem-solving skills and collaborative work in elementary school children by DT as a teaching method. The subjects for investigation are Art/Crafts [Kunst/Werken] and General Science & Social Studies (GS&SS) [Sachunterricht]. The latter is specific to German elementary schools and is related to STEM education, geography, history and everyday culture. In order to answer the research question, different kinds of qualitative studies were conducted: preliminary studies by means of questionnaire surveys with educators and in-service teachers [32], pilot studies in elementary schools with children and in-service teachers [33], a study within the framework of an interdisciplinary student teacher seminar [34] and two main studies in Art/Crafts and GS&SS.

In all learning scenarios the children were taught along the six phases of the iterative DT process *Understand, Observe, Point of View, Ideate, Prototype, and Test,* to be seen in figure 2 [(own illustration adapted from HPI Academy) 20]. In order to make the terms and the respective tasks better understandable for elementary school children, the names of the phases were slightly modified into instructions for action*: Understand the problem and the Task, Observe People, Animals or Things, Gather Knowledge, Develop Ideas to implement, Build Prototypes, Present your Prototype* [33]. In the pilot studies, the children were given a cross-curricular task, like designing the *Perfect Reading* Place [32, 33]. The two main studies were conducted in Art/Crafts and in GS&SS. For this purpose, student teachers at the University of Education Freiburg developed learning scenarios (LS) after being taught DT by a designer. The task in this project-oriented seminar was to develop specific learning contents associated with these two subjects and to include the overarching guiding principle ESD according to the education plan of the federal state of Baden-Württemberg at the same time [35]. The material that should be used for prototyping consisted exclusively of used or recyclable items and was collected by the children [34].

Summarizing one can say that in all three kinds of qualitative studies, conducted in the framework of the research project, the didactic principles were applied due to the specific overarching character of DT [21, 22]. DT thus corresponds very well with general and specific didactic principles [27, 29] in order to implement ESD. The detailed presentation of the methodical procedures and results of all studies can be found in Högsdal and Grundmeier [32, 33, 34].

ESD through DT in Further Education and Vocational Training in the Textile Sector

Based on the results obtained in the research project the following hypothesis can be derived: “Design Thinking (DT) can also be used for ESD in higher education and vocational training.” This seems all the more logical because of the character of DT which is not bound to a specific discipline but transcends disciplines. DT has a multidisciplinary approach and enables interdisciplinary collaboration in groups. The method encourages critical thinking and enables creative solutions to wicked problems. It is important that in the design process mistakes should be made in order to arrive at better solutions without fear of criticism [21, 22, 23]. DT is popular because it is not limited to certain disciplines but rather a mindset to solve complex problems in all areas [23].

A pilot DT online workshop on DT’s potential for ESD was conducted within the framework of the EU Erasmus+ project Fashion DIET (https://fashiondiet.eu, accessed 01.08.2022) in June 2021 at the Gheorghe Asachi Technical University of Iași, Romania. About 70 participants, lecturers, high school teachers and educators in the textile and fashion industry from Bulgaria, Romania and Germany were involved. The online workshop included an introduction to the history and theory of DT and a detailed explanation of its principles and phases by means of the well-known d.school exercise *The Perfect Wallet* [36]. This exercise was given to the student teachers in the interdisciplinary seminar in order to get familiar with DT [34]. It is particularly suitable to illustrate the working methods and principles of DT in a short time and let the participants experience a fast design sprint, according to fixed times. The high user orientation of DT becomes clear through the fast and multiple change of roles between consumers and designers [36]. The aspect of “fast prototyping” and the handling of materials, especially the fact that ideas arise directly from the material and during the process of building, thus can be sensually experienced also by non-designers [37, 38].

At the end of the workshop, a discussion based on guiding questions was conducted by means of a Padlet group

work. Padlet is a software that creates a digital whiteboard where text, images, videos, links, voice recordings, screen recordings, and drawings can be placed, enabling collaborative work [39]. The participants should express their feedback and opinions towards the potential of DT in general as well as its potential to sensitize learners to ESD or sustainability topics. Their participation in the group work was voluntary and they could choose whether to express their opinion under their real names or anonymously. For each question multiple answers could be given. The following tables give an overview of the questions and respective answers:

TABLE 1: How can Design Thinking (DT) be used as a method for ESD?
With a total of N=5 answers, n=1 answer under real name (rn) and n=4 anonymous (an) answers were given.

DT is an iterative process. It will help to develop new products from used textiles.	rn
I am at loss what to answer here, as this is more or less the only method we are using as designers.	an
By applying designers' sensibility as a method of ESD.	an
By focusing on the consequences of our actions, beginning with everyday life and thus also on the impact that is has on others and on the planet in a distant future.	an
By developing responsibility, team work and creativity through specific group exercises	an

TABLE 2: How can we promote the idea of circular fashion by means of DT?
With a total of N=7 answers, n=4 answers under real name (rn) and n=3 anonymous (an) answers were given.

I am reflecting on it.	rn
Zero waste fashion design patterns (DIANA)	rn
I would make brain storming sessions on reducing the waste i.e.	rn
I believe this is a great method for self-management and it can be developed as a way of life, for solving all our daily problems.	an
In this case, the problems that have to be solved, refer to reduce or eliminate the pre- and postconsumer waste.	an
Taking into consideration the non-linear nature of design thinking.	an

TABLE 3: If not (only) for implementing ESD, what else is DT good for?
With a total of N=14 answers, n=6 answers under real name (rn) and n=8 anonymous (an) answers were given.

For self-development	rn
For team work	rn
Concrete issue: developing a filter for microplastic adding to my washing machine.	rn
I will try later to simulate a problem-solving task by this method. A technical one.	rn
It can be used in any moment a class or group of students is blocked and cannot go further in the task they have to complete.	rn
Simply you put aside everything and get started from point zero with the idea of design thinking.	rn
I use this method in almost all my workshops with students for personal development purposes.	an
It is useful for any question or problem you have to tackle with.	an
To develop critical thinking.	an
For interaction.	an
For collaborative design.	an
To find good ideas that can solve everything that exists in the team.	an
For problem solving, no matter what the problem is.	an
This method can be used for students to learn interactive teaching methods they could implement when they selves will be teachers or trainers.	an

TABLE 4: I would like to annotate
With a total of N=5 answers n=1 answer under real name (rn) and n=4 anonymous (an) answers were given.

In any way... I would like to rethink of some things from it.	rn
It looks great.	an
I very much enjoyed the presentation.	an
It was really an interesting approach.	an
Design thinking can actually be applied for solving any technical issue.	an

Discussion of the results

The participants of the online workshop did not have the opportunity to do a "real design sprint" of the *Perfect Wallet* exercise. Due to the online format of the conference, they sat in front of their laptops spread over several countries and could give their answers only based on the presentation about DT and the moderator's explanations of the *Perfect Wallet* exercise. Despite these limiting circumstances, their answers can be considered remarkable in terms of comprehending and highlighting the potential of DT. It was possible for them to recognise and understand the following aspects of DT:

- its iterative character and potential for fostering creativity and teamwork (table 1)
- its potential for self-management and problem-solving as well as its nonlinear character (table 2)
- its potential for self-development and for collaboration and interaction in team settings as well as for problem-solving in technical issues (table 3 and 4)

In summary, it is noticeable that the participants repeatedly expressed their approval and great interest in this method throughout all answers.

CONCLUSION FOR ESD IN FURTHER EDUCATION AND VOCATIONAL TRAINING IN THE TEXTILE SECTOR

The textile and fashion industry of today is characterised by constant growth processes, very short production cycles, and low sales prices with a high ecological and social impact, which has to be changed into a sustainable-oriented circular economy [40]. ESD as a guiding principle should be implemented in textile education from kindergarten to university courses in order to develop a sustainable mindset throughout a person's lifetime and transform the textile chain into a circular system with professionals who will bring about a real change towards sustainability in their fields.

As an interdisciplinary educational concept with a cross-sectional task, ESD not only serves to gain basic knowledge in order to cope with key problems but at the same time serves to acquire design competence. These characteristics equally apply to DT [21, 22, 23, 24]. On the surface, companies may seem to have used DT to transform their products whereas in reality they have undergone a transformation themselves [23].

The international pilot-workshop with university lecturers, teachers and educators in the textile and fashion sector was a first step to implement DT in ESD within the framework of the EU project Fashion DIET. In contrast to the studies that were conducted in the context of the PhD research project, this workshop was not led by a designer. That can be considered as a decisive step towards a transfer of design methods into educational contexts at the end of the PhD project. It served to verify and ensure that the knowledge about design competence in order to enable ESD through DT obtained from the previous studies is transferable to further study areas. In this way, knowledge and skills from the design discipline can be transferred to various educational fields, which underpins the transdisciplinary character of design.

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