Enhancing design literacy for sustainability

Craft-based design for sustainability in lower secondary education in Norway

Ingvill Gjerdrum Maus

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Oslo, 6th of April 2020

Ingvill Gjerdrum Maus

Abstract

This PhD thesis consists of three articles and the synopsis of a research project on the enhancement of lower secondary students' design literacy for sustainability through craft-based design education. This study responds to the need for research-based knowledge on operationalised education and students' experiential learning on *design* and *sustainability* in the Norwegian school subject Art and Crafts, and contribute to the development of *Education for Sustainable Development (ESD)* in general design education. I have approached the topic with the main research question: *Which possibilities and challenges are involved in craft-based design education to enhance youths' design literacy for sustainability?*

The project was conducted as an action research informed by semi-structured group interviews, in collaboration with students and two teachers in the school subject Art and Crafts in a Norwegian lower secondary school in 2015–2016. The semi-structured group interviews in the first case study, called Case Keramikk, included seven students in 10th grade (age 15–16) who were attending a project on making utility objects or sculptures in ceramic clay. The action research in the second case study, called Case Sveip, included 26 students in 8th grade (age 12–13) who were attending a project of making boxes using the bentwood technique. The data consist of video recording transcripts, timekeeping, observation notes and students' written responses to tasks and self-evaluation questions.

The theoretical perspective in this thesis is that a main purpose of craft-based design education for youth consists of their development of design literacy for sustainability. Design literacy is understood as a competence of product design that support development of sustainable environments (Nielsen & Brænne, 2013). The development of design literacy is understood as a process that take place when students engage with examples on craft-based design whereby their critical thinking, judgement, will and imagination encounter knowledge on Design for Sustainability (DfS), in accordance with theory of kategorialen Bildung for development of holistic knowledge (Klafki, 1959/2001, 1985/2001).

Among the results are two models and the related analysis of the two case studies, which demonstrate the possibilities and challenges involved in design education to enhance youths' design literacy for sustainability. In Article 1, I present two diverging students' viewpoints on environmental concerns as either a useful topic in design and crafts or a disruptive topic that will shift the educational practice towards theoretical work. I employ these viewpoints in the

development of the *Model of educational practice in DfS, variation 1* (Maus, 2017, p. 164), which outlines the students' engagement with their design products, the information on the products' potential environmental impacts and the influences between these. I discuss the possibility of exemplifying DfS in the students' design and craft products and process, and through this enhance the students' understanding of environmental concerns as relevant. Article 2 and 3 inquire into two approaches for students' engagement with examples of DfS principles and practices in craft-based design. Also, both articles and this synopsis employ the *Model of educational practice in DfS* variation 2, 3 and 4 in the discussion of the results.

Article 2 presents the *Model of Life Cycle Thinking (LCT) in craft-based design* (Maus, 2019a, p. 3) that visualises the possibilities for students' use of experiential learning from craft-based design in LCT on their products, which was located in Case Keramikk. The students used experiential learning that corresponds to DfS practices for eco-efficiency, eco-effectiveness and product durability in the production phase of their products, moreover distinctive characteristics of materials, products and production decisive for following these DfS practices in the phases of material extraction, use and disposal.

Article 3 presents operationalised education and students' expressed experiential learning on craft-based DfS in Case Sveip. This includes the students' engagement with introductions and tasks that exemplify DfS principles and practices in their craft-based design products and the students' self-evaluation of their experiential learning. The students responded that they experienced DfS as comprehensible and relevant, but the self-evaluation results indicate they were further along in their development of design literacy in DfS practices for eco-efficiency and eco-effectiveness to reduce direct environmental impacts than DfS practices for product durability to reduce indirect environmental impacts. I discuss whether the result can be attributed to the distinctive characteristics of these DfS practices.

This research project began with students' worries that the topic of sustainability would disrupt the practical work. However, the case studies showed that the students found DfS useful and that their reflections on the topic consumed a modest amount of time (i.e. 1.8% in Case Keramikk and 7.5% in Case Sveip), which was expended when making decisions about the design in sketches, work drawings and material selection and while assessing the finished products with the use of acquired competence on the materials, products and production. Here, I see possibilities for enhancement of youths' design literacy for sustainability.

Sammendrag

Denne phd-avhandlingen består av tre artikler og en kappe som omhandler et forskningsprosjekt om hvordan håndverksbasert designundervisning kan styrke ungdomsskoleelevers utvikling av designkompetanse for bærekraft. Studien imøtekommer behovet for forskningsbasert kunnskap om operasjonalisert undervisning og elevers erfarte læring om *design* og *bærekraft* i det norske skolefaget Kunst og håndverk, og bidrar gjennom dette til utvikling av *Utdanning for bærekraftig utvikling (UBU)* i grunnskolen. Jeg har tilnærmet meg temaet med hovedforskningsspørsmålet: *Hvilke muligheter og utfordringer ligger i håndverksbasert designundervisning for å styrke ungdommers designkompetanse for bærekraft?*

Forskningsprosjektet ble gjennomført som en aksjonsforskningsstudie informert av semistrukturerte gruppeintervju, i samarbeid med elever og to lærere i faget Kunst og håndverk i en norsk ungdomsskole i 2015–2016. De semistrukturerte gruppeintervjuene i den første casestudien, kalt Case Keramikk, omfattet sju elever i 10. klasse (alder 15–16 år) som deltok i et prosjekt der de laget enten en bruksgjenstand eller en skulptur i keramisk leire. Aksjonsforskningen i den andre casestudien, kalt Case Sveip, omfattet 26 elever i 8. klasse (alder 12–13 år), som deltok i et prosjekt der de laget treesker i sveipeteknikk. Datamaterialet består av videotranskripsjoner, tidsregistreringer, observasjonsnotater og skriftlige elevbesvarelser på oppgaver og egenvurderingsspørsmål.

Det teoretiske perspektivet i avhandlingen er at utvikling av ungdommers designkompetanse for bærekraft er et sentralt mål for den håndverksbaserte designundervisningen. Designkompetanse er her forstått som praktisk kunnskap i produktdesign som støtter utvikling av bærekraftige miljø, i henhold til Nielsen og Brænne's (2013) beskrivelse av design literacy. Elevenes utvikling av designkompetanse er forstått som en prosess som oppstår i arbeid med praktiske eksempler der elevene bruker sin kritiske tenkning, vurderingsevne, vilje og fantasi i møte med kunnskap om design for bærekraft (DfB), i tråd med teori om kategorial danning for utvikling av helhetlig kunnskap (Klafki, 1959/2001, 1985/2001).

Blant resultatene er to modeller med tilhørende analyser av de to casestudiene, som viser muligheter og utfordringer for å styrke designkompetanse hos ungdom. I Artikkel 1 presenterer jeg to motstridende elevsynspunkt på miljøhensyn som enten et nyttig tema i design og håndverk eller som et forstyrrende tema som vil endre undervisningspraksisen i retning av mer

teoretisk arbeid. Jeg anvender disse synspunktene i utviklingen av *Modell av undervisnings-praksis i DfB, variasjon 1* (Maus, 2017, s. 164). Denne modellen skisserer elevenes arbeid med sitt eget designprodukt, informasjonen om produktets potensielle miljøpåvirkning og den gjensidige påvirkningen mellom disse. Jeg diskuterer muligheten for å eksemplifisere DfB i elevenes designprodukter og produksjonsprosesser, og gjennom dette fremme elevens forståelse av miljøhensyn som et relevant tema. I Artikkel 2 og 3 studerer jeg to tilnærminger til elevarbeid med eksempler på DfB prinsipper og praksiser i håndverksbasert design. I tillegg bruker jeg *Modell av undervisningspraksis i DfB,* variasjon 2, 3 og 4 i diskusjoner av resultatene i begge artiklene og i kappen.

Artikkel 2 presenterer *Modell av livsløpstenkning (LLT) i håndverksbasert design* (Maus, 2019a) som visualiserer mulighetene for at elever kan bruke erfart læring fra håndverksbasert design i LLT om produktene sine, som var lokalisert i Case Keramikk. Elevene brukte erfart læring som samsvarer med DfB praksiser for øko-effektivitet, sirkulær ressursbruk og produkt holdbarhet i produktenes produksjonsfase, samt de ulike egenskapene i materialer, produkter og produksjonsprosesser som er avgjørende for å utføre disse DfB-praksisene i material-utvinning, bruk og avhending av produktene.

Artikkel 3 presenterer operasjonalisert undervisning og elevers erfarte læring fra håndverksbasert DfB i Case Sveip. Dataene omfatter elevens refleksjoner i introduksjoner og oppgaver der DfB prinsipper og praksiser er eksemplifisert i deres egne håndverksbaserte design produkter, samt elevenes egenvurdering av sitt erfarte læringsutbytte. Elevene ga uttrykk for at de opplevde DfB som forståelig og relevant. Imidlertid indikerer egenvurderings-resultatene at elevene var kommet lenger i utvikling av designkompetanse om DfB praksiser for øko-effektivitet og sirkulær ressursbruk som reduserer produkters direkte miljøpåvirkning, enn DfB praksiser for produktholdbarhet som reduser produkters indirekte miljøpåvirkning. Jeg diskuterer om dette utfallet kan skyldes de ulike egenskapene til disse DfB praksisene.

Forskningsprosjektet startet med elevers bekymringer for at temaet bærekraft vil forstyrre det praktiske arbeidet. Imidlertid viser casestudiene at elevene syntes DfB var nyttig, samt at deres refleksjoner over temaet tok begrenset tid (i.e. 1,8% i Case Keramikk og 7,5% i Case Sveip). Denne tiden ble anvendt i situasjoner der elevene tok avgjørelser om design i skisser, arbeids-tegninger og materialvalg, og mens elevene vurderte de ferdige produktene sine med bruk av ervervet kompetanse om materialer, produkter og produksjon. Her ser jeg muligheter for å styrke ungdoms designkompetanse for bærekraft.

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Article 1: Maus, I. G. (2017). Developing holistic understanding in design education for sustainability. In A. Skjerven & J. B. Reitan (Eds.), *Design for a sustainable culture: Perspectives, practices and education* (pp. 157–170). Abingdon, UK: Routledge. URL: https://www.taylorfrancis.com/books/e/9781315229065/chapters/10.4324/9781315229065-12

Article 2: Maus, I. G. (2019a). Developing design literacy for sustainability: Lower secondary students' life cycle thinking on their craft-based design products. *FormAkademisk – Research Journal for Design and Design Education, 12*(1), 1–18. DOI: https://dx.doi.org/10.7577/formakademisk.1725

Article 3: Maus, I. G. (2019b). Enhancing design literacy for sustainability among youth in crafts-based design education. *Techne Series – Research in Sloyd Education and Craft Science A, 26*(1), 93–108. URL: https://journals.hioa.no/index.php/techneA/article/view/2851

List of abbreviations

The following abbreviations are used in this thesis:

DfS: Design for Sustainability

ESC: Education for Sustainable Consumption

ESD: Education for Sustainable Development

LCA: Life Cycle Assessment

LCT: Life Cycle Thinking

TBL: Triple Bottom Line

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1. Introduction

This thesis investigates a topic of strong current interest: the possibilities and challenges in enhancing design literacy for sustainability among youth through engagement with the principles and practices of *design for sustainability (DfS)* in craft-based design education at the lower secondary level. The research project focuses on the path forward for youths' design and crafts education in these times of environmental challenges. In Norway, formal design and crafts education for youth are provided in public education in the compulsory school subject Art and Crafts[1] in the 1–10th grades (age 6–16). The two case studies of this research project were conducted within this school subject in the 8th and 10th grades.

One of the early agitators for environmentally considerate design, today known as DfS, was the influential designer and educator Victor Papanek. In the 1970s and 1980s, he raised fundamental questions on the purpose, values and content of design education. In his book *Design for the Real World: Human Ecology and Social Change*, Papanek pointed out that designers are heavily implicated in pollution. He accused the industry of valuing the production of glittering consumer gadgets for abundant societies above basic agricultural implements for underdeveloped areas of the world and the design educations' philosophy of being a mixture of self-indulgent and self-expressive bohemian individualism that is materialistic, profit-oriented and brutal (Papanek, 1985, pp. 248–321). Although Papanek wrote from a position in professional design education, his questions remain valid for design education at all levels.

Today, responsibility for environmental sustainability is valued and formally implemented in general design education for youth in Norway, but the field lacks research-based knowledge on how to put these values into practice in the school studio. The necessity of developing educational content, or 'subject matter', and related educational practice on the topic is unarguable, because all these young students affect environmental sustainability through their use and consumption of design products. Associated knowledge on DfS has been developed within and for professional design education at the university level, but must be developed further within the frames of the general design education. The students' development of understanding of educational topics depends upon them seeing the topic as exemplified in their

[1] In Norwegian Kunst og håndverk.

educational practice and as relevant for their past, present and future lives (Klafki, 1959/2001). Because general design education concerns products the young students craft themselves, I choose to call it *craft-based DfS*. This is a design practice with its own terms and needs for research, alongside professional design education. Craft-based DfS carries the term's origin, but also includes development theories to serve the purpose of the design and crafts education for the youth and the associated education for Specialised Teacher Training in Design, Art and Crafts[2]. The methodological approach to developing DfS from within the frames and practices of youths' design education is a mixed methodological approach through which semi-structured group interviews inform action research.

1.1. Background and motivation

This project springs from the frustration expressed to me by the pre-service teacher students and university college teachers in the educational programme for Specialised Teacher Training in Design, Art and Crafts[3] at Oslo University College[4] during the school year of 2007–2008. That year, I stepped in as a university college teacher in the topic Materials and Environmental Knowledge[5] in this educational programme. The previous year, 2006, a new curriculum in Norwegian primary and lower secondary schools, also for the school subject Art and Crafts, had been launched. In this curriculum, concerns for environmental sustainability in product design were given a distinct position by including a competence aim of life cycle assessment (LCA) (Utdanningsdirektoratet, 2006a). The inclusion of this topic in the national curriculum was in line with the international initiatives for *Education for Sustainable Development* (ESD), whereby all disciplines are intended to respond and contribute (United Nations Educational, Scientific and Cultural Organization [UNESCO], 1997, 2005a, 2012, 2014a, 2014b, 2016, 2018).

The pre-service teacher students stated that they considered the educational topic of concerns for environmental sustainability to be relevant and important, but they did not know how to approach it – and neither did the university college teachers, myself included, because we had

[2] In Norwegian Faglærerutdanning i formgiving, kunst og håndverk, today Faglærerutdanning i design, kunst og håndverk.
[3] Previously called Teacher Training in Art and Design.
[4] Today OsloMet – Oslo Metropolitan University.
[5] In Norwegian Material- og miljølære.

no experience or research on this topic to draw on. The pre-service teacher students' worries concerned how to enfold the comprehensiveness, complexity and theoretical aspects of this topic into the practical design and crafts education for children and youth. The university college teachers also questioned how to evaluate the pre-service teacher students' work in academic tasks on the topic. My own concerns included one more issue; in the educational programme, environmental concerns were taught mainly in the lessons on materials and environmental knowledge. This gave the topic a one-dimensional focus, whereby design products were reduced to the sum of their materials, while other product qualities of influence on environmental impacts from the product's life cycle were given less attention.

Now, through this PhD project, the opportunity has arisen to develop knowledge on education in DfS among youth. The project was inspired by the fundamental ideas of educational action research (Elliott, 2007; Hiim, 2016; McKernan, 2008; McNiff, 2013, 2014; Stenhouse, 1975), including starting out as a democratic project with the goal of improvement and change (Hiim, 2016) and being helpful to the teachers and responsive and to the students (McKernan, 2008, pp. 109–122). This PhD project sprang from pre-service teacher students' requests for improvements in the programme for Specialised Teacher Training in Design, Art and Crafts on the educational topic of teaching environmentally considerate design and crafts to youth.

Throughout this PhD project, staying in touch with these students' questions through developing and teaching DfS has been a source of inspiration, motivation and correction on their needs for knowledge. Thus, while conducting this research project, I have also returned to teach materials and environmental knowledge among these students, giving me regular opportunities to discuss the topic with them.

1.2. The context of this research project

This thesis concerns design and crafts education for youth. In Norway, formal education for youth in design and crafts is provided in public education through the school subject Art and Crafts in the 1–10th grades (age 6–16). It is within this Art and Crafts education in the 8th and 10th grades that the two case studies in this research project were conducted.

The school subject Art and Crafts formally entered the Norwegian public school in 1889 as education within Drawing, Woodwork and Textile[6] (Nielsen, 2009, pp. 35–41). These were unified under the school subject Forming in 1960. This combination of subject areas in one school subject in Norway is unique among the Nordic countries and has brought different traditions into the field of educational practice and research. Qualifications for teaching in this school subject can be acquired through the Specialised Teacher Training in Design, Art and Crafts or the education for classroom teachers where specialisation in Art and Crafts is optional. Further qualifications can be obtained through the Master in Art and Design Education[7], which was started in 1976. The research field on Art and Crafts education for children and youth was established in 1995 when The Oslo School of Architecture and Design (AHO)[8] opened their PhD program to research within design education. Also, in 1998 did the first educational practitioners with master degree in Art and Design to enter doctoral programmes receive their doctoral degree at the University of Bergen (UiB) and the University of Oslo (UiO)[9] (Nielsen, 2008a, 2008b). However, education in environmentally considerate design is a nascent topic within this field of research. Therefore, this thesis draws on international research on DfS from the field of professional design and design education. In particular, knowledge on DfS principles and practices proved useful as educational content in this research project (see section 5.2 and 5.3), while educational methods were less relevant because of the different frames for the educational practices at the professional and general levels of education.

This research project is part of the work in the research group Design Literacy, of which I am a member, and from which my PhD research fellowship was announced in 2011 and this project was launched. The members of the research group Design Literacy are drivers in the research on the implementation of aspects for sustainability in design education at all ages from Kindergarten to PhD level. In the editorial for the special issue of *FormAkademisk – Research Journal for Design and Design Education* from the conference *DRS//CUMULUS Oslo 2013 – 2nd International Conference for Design Education Researchers*, Nielsen, Brænne and Maus (2015) wrote that design learning for sustainable development starts in childhood, and future

[6] In Norwegian tegning, sløyd og håndarbeid.
[7] In Norwegian Master i Design, kunst og håndverk, former Hovedfag i forming.
[8] In Norwegian Arkitektur- og designhøgskolen i Oslo (AHO).
[9] In Norwegian Universitetet i Bergen (UiB) and Universitetet i Oslo (UiO).

research on this topic is appreciated, as only a handful of projects are to be found at the present. This summary also applies to the state of research on design learning and education for sustainable development among youth in Norway. Although some research studies have been published since, this thesis contributes research attention to issues that have, for the most part, previously been mainly ignored (see chapter 2).

1.3. The concept of education in craft-based DfS

The field of DfS emerges from professional design and design education. Clune (2010) writes from the position of industrial design education for sustainability that it is design education for, not on, sustainability. Sustainability refers to the sustainable societies we aim to achieve through positive changes. Design refers to development of technical and social solutions that enable change, where design is seen as part of both the problems and the solutions to overconsumption of resources in products and everyday behaviour in unsustainable societies. Education includes the development of understanding of 'how to design' through design work in the studio, and should also focus on the question of 'what to design' (Clune, 2010).

In this thesis, knowledge from the field of DfS is used and transformed within the field of craft-based design education for youth. The knowledge employed focus on practices in product design for environmental sustainability. To highlight the differences in practices between professional designing for industrial production and the youths' education in designing and crafting, this thesis uses the term *craft-based DfS*. The development of this terms was inspired by the term *craft-based upcycling* (Sung & Cooper, 2015).

1.4. Research questions

The development of education in DfS for youth draws both on the existing design and crafts education developed through the history of the school subject Art and Crafts, and on professional DfS. As Michl (2002) wrote, new design solutions are usually redesigns of old solutions. This project approaches the development of educational practice in DfS by assessing the potential that already lies in the educational practice and is embedded in corresponding DfS practices. This *research project* is guided by the main research question:

> Which possibilities and challenges are involved in craft-based design education to enhance youths' design literacy for sustainability?

This question was asked and answered through the discussion of the results from the articles (see chapter 5 and 6), each of which was driven by a subordinate research question.

In *Article 1*, the research question concerned establishing knowledge on the students' perspectives on learning DfS:

> How can the design process for sustainability open students' understanding of Design for Sustainability (DfS) as an educational practice relevant for the purpose of their present situation of creative and practical schoolwork, as well as for their future?

This part of the study narrowed down the focus to the practical solutions in product design, which can be observed and modified in the school studio and lead to the development of a model of educational practice in DfS.

In *Article 2*, the research question addresses the students' work, specifically, what examples of DfS practices do the students experience and how does their practical work support learning about these:

> What kinds of experiences from making a craft-based design product do the students draw on when asked to reflect on their practices, their products' qualities and the environmental considerations in these? Also, what kinds of environmentally considerate design practices correspond with the students' experiences and therefore potentially can be exemplified in their work?

This led to the development of a model for how students' craft-based designing of a product informed their reflections on questions on environmental considerations in the material extraction, production use and disposal of their product.

In *Article 3*, the next step in the research project consisted of the development and evaluation of an educational practice in DfS, which work was guided by the research question:

> What possibilities and challenges are involved in enhancing design literacy among youth through engagement with DfS principles and practices?

These research questions aim at illuminating the possibilities and challenges in the development of education in craft-based DfS for youth.

1.5. The outline of this thesis

This article-based thesis consists of this synopsis[10] and three articles and is organised in the following six chapters. This introduction in *Chapter 1* presents the topic, the background, the context and research questions for this synopsis and the three articles. *Chapter 2* positions this thesis in a literature review on associated research and related political documents and curricula. *Chapter 3* presents and elaborates on the theoretical frameworks of this thesis, including design literacy for sustainability, DfS and theory of knowledge and knowledge development. *Chapter 4* elaborates on the methods and case studies. *Chapter 5* presents the results and how these are integrated across the articles, while in *Chapter 6*, these results are discussed in the light of the main research question, elaborating on the implications of the results and recommending topics for future research.

[10] In Norwegian 'kappe'.

2. Literature and document review

In this chapter, I present a literature review on environmental *sustainability* as a topic in the general *crafts* and *design* education in the Norwegian school subject Art and Crafts. Because this is an emerging field of research, the review was conducted with inspiration by Maxwell's (2006) description of literature reviews' relevancy *for* research with implications for the project's design, conduct and interpretations (Maxwell, 2006). Relevant literature was located and the review supplemented successively, through search in journals (i.e. *FormAkademisk – Research Journal for Design and Design Education, Techne Series – Research in Sloyd Education and Craft Science A, Nordic Journal of Art and Research* and *Studies in Material Thinking*), database engines (i.e. *Education Resources Information Center [ERIC]* and *Open Digital Archive [ODA]*) and conference proceedings (e.g. *The International Conference on Engineering and Product Design Education [E&PDE]*). Associated documents on political initiatives driving the implementation process of sustainability in education were consulted. The position of my work was established by structuring the review on the framework for curriculum inquiry, which includes: 1) *the ideological* political intentions; 2) *the formal* introduction in curricula; 3) *the perceived* interpretations in research; 4) *the operationalised* educational practice; and 5) *the experiential* learning among students (Goodlad, Klein & Tye, 1979; Nielsen, 2009, pp. 26–31). This structuring indicates a nascent field with all its research published within a decade, which possibly is the reason for the following status of research:

- Documents on the ideological and formal domains, and some research on the perceived domain arguing for the inclusion of sustainability in the design education.
- A gap in the research-based knowledge on the operationalised education and students' experiential learning on design and sustainability, where I position my work.

The overview coincides with the description of Goodlad et al. (1979, pp. 64–65) of operational and experiential domains as largely uncharted territory. This research project was therefore designed to develop knowledge from the students' expressed experiential learning and operationalised education towards the perceived interpretation. The articles selected for this review were written in the context of Norwegian general education and published in international publications on design education that are frequently used by Norwegian researchers. By expanding the scope, I could have included some more works on related contexts, for example pre-school education (Odegard, 2012) or art education and education in

other countries (Özsoy, 2016). Hofverberg (2019) conducted a similar literature review on the topic of craft in Environmental and Sustainability Education (ESE) journals and research handbooks for her PhD thesis at Uppsala University, Sweden, and came to the same conclusion that only few works have been published on the topic (Hofverberg, 2019, p. 19). Brief, preliminary versions of this review are employed in the discussion in Article 2 (Maus, 2019a) and the introduction in Article 3 (Maus, 2019b) of this thesis.

2.1. Ideological political intentions

The *ideological* intentions of implementing sustainable development in education are expressed in several international initiatives, including the following: Various international initiatives for *sustainable development* emphasise education as a key factor for public participation towards achievement of the sustainability goals (World Commission on Environment and Development [WCED], 1987, A Policy Framework, para. 3.2.; United Nations Conference on Environment & Development [UNCED], 1992, para. 36.3.). For example, the United Nations' (UN) *Sustainable Development Goal (SDG) 12 – ensure responsible consumption and production patterns* – which seeks to reduce waste generation through prevention, reduction, recycling and reuse (UN, 2015, para. 12.1–12.c.), requires design competence among the general public. *Education for Sustainable Consumption* (ESC) (United Nations Environment Programme [UNEP], 2010) and *Education for Sustainable Development* (ESD) (UNESCO, 1997, 2005a, 2012, 2014a, 2014b, pp. 47–48, 2016, 2018) are essential initiatives in this context. The aims of ESD are to implement principles and practices for sustainable development in all education and to enhance the knowledge, skills and values needed to develop solutions for sustainability challenges (UNESCO, 2005a, pp. 6–7, 2014a, pp. 3, 9). ESD is inter- and transdisciplinary, and all disciplines can contribute (UNESCO, 2018, p. 35). Norway's ESD-associated strategy, *Utdanning for bærekraftig utvikling* (UBU) puts the focus on other aspects than production of products (Kunnskapsdepartementet[11], 2012; Utdanningsdirektoratet[12], 2006b) and associated documents omits the school subject Art and Crafts (Melkild, 2016, pp. 28–31, 50). At this point, the national initiative are not attending to all aspects of the international initiatives.

[11] In English Ministry of Education and Research.
[12] In English The Norwegian Directorate for Education and Training.

2.2. Formal introduction in curricula

The *formal* implementation of sustainability was conducted in the Norwegian core curriculum for primary, lower and upper secondary education in 1993, as a separate chapter called *The Environmentally Aware Human Being*[13] (Royal Ministry of Education, Research and Church Affairs, 1999, pp. 8–9, 51–54). Moreover, it was extended as a cross-curricular topic in the core curriculum passed in 2017 (Utdanningsdirektoratet, 2018). In addition are the students' rights to learn critical thinking, ethical acts and environmental awareness incorporated in The Education Act (1998, section 1.1). Beginning in 1997, the curriculum for the school subject Art and Crafts included environmentally conscious use of materials (Royal Ministry of Education, Research and Church Affairs, 1999, pp. 203–217) and the consequences for sustainable development and environments of products' life cycles in 2006. Environmentally conscious use, reuse and durable use of materials are emphasised in the new Art and Crafts curriculum that will be implemented in 2020 (Utdanningsdirektoratet, 2006a, 2019). Furthermore, sustainability also has been formally introduced into the topics of Technology and Design in cross-curricular activities between Art and Crafts, Nature Science and Mathematics (Utdanningsdirektoratet, 2013) and for the optional course Design and Redesign (Utdanningsdirektoratet, 2012).

2.3. Perceived interpretation in research

The *perceived* perspectives in research concern the possibilities for youths' development of design competence for democratic participation in sustainable development and consumption by experiencing and reflecting upon design and crafts practice (Digranes & Fauske, 2010; Illeris, 2012; Lefdal, 2005; Lutnæs, 2015a, 2015b, 2017, 2019; Lutnæs & Fallingen, 2017; Nielsen, 2009; Nielsen & Brænne, 2013, Nielsen & Digranes, 2007, 2012; Orheim & Nielsen, 2017). Empirical studies among teachers in Art and Crafts concern perspectives on the cultivation of eco-literacy (Fallingen, 2014) and sustainable perspectives on material use (Idland, 2015). Associated studies concern perspectives on the topic expressed in a professional journal on design education at primary and secondary level (i. e. Form) and among related

[13] In Norwegian Det miljøbevisste menneske.

occupational groups (e.g. artist, craftsperson, museum guide and museum curator) (Bangsund, 2017; Bjønnæs, 2014; Jenssen, 2013; Steinkjer, 2015).

The combination of the topics of art and crafts in the school subject Art and Crafts provides multiple traditions for the development of practice in ESD and UBU, which has been explored by Lutnæs and Fallingen (2017) and Illeris (2012). Lutnæs and Fallingen (2017) identify four entrances in the traditions of the school subject Art and Craft to enhance *eco-literacy* as an approach to UBU. They define eco-literacy as a combination of awareness raising and change competency[14] concerning the reciprocity between humans and nature. Lutnæs and Fallingen (2017) find that the traditions of *aesthetical experiences* and *critical reflection*[15] hold the strongest potential for enhancing *awareness*, while *practical creative work* and *responsible product development*[16] hold the strongest potential for enhancing *change competency* (Lutnæs & Fallingen, 2017). Illeris (2012) provides a birds-eye perspective on possible practices with environmental problems on the agenda in Nordic education, by defining four cornerstones for *Art Education for Sustainable Development* (AESD). These are *critical art education*, *poststructuralist strategies*, *visual culture pedagogy* and *community-oriented visual practices*. Critical art education is described as transformative pedagogy with analysis and design based on ideas of liberation, creativity and consciousness, which stands in contrast to child-centered creative arts education. The aim of critical art education is to create change in habits and systems to become more humane, respectful and harmonious with the environment. The educational practices in the case studies of my research project (see sections 4.3. and 4.4.) are related to the tradition of responsible product development (Lutnæs & Fallingen, 2017) and the cornerstone of critical art education (Illeris, 2012).

The relevance of including sustainability in Norwegian design education for children and youth has been discussed in several publications. Nielsen and Digranes (2007) elaborate on youths' needs for design knowledge in situations of user participation. Digranes and Fauske (2010) discuss conditions for the development of *citizenship*, *citizenspirit* and *citizenpride* through design education with the emphasis on design practices and design qualities that enhance

[14] In Norwegian bevisstgjøring and endringskompetanse.
[15] In Norwegian estetiske erfaringer and kritisk refleksjon.
[16] In Norwegian praktisk skapende arbeid and ansvarlig produktutvikling.

environmental sustainability. Nielsen and Digranes (2012) describe design literacy as a competence not only for designers but also for citizens as stakeholders in sustainable development through consumption. They account for traditions in art, design and crafts education. Moreover, present their work on identifying challenges in and between the different levels of education to strengthen the educational enhancement of design literacy. They argue for empirical studies in operationalised and experiential learning on the issue at all levels of education and introduce a collection of stories from design education through semi-structured group interviews as an approach (Nielsen & Digranes, 2012). Nielsen and Brænne (2013) describe *design literacy*, argue the role of design literacy in consumption for longer-lasting products and raise the question of what challenges need to be addressed in design education to enhance design literacy (Nielsen & Brænne, 2013). Their description of design literacy form a part of the theoretical framework in this thesis, which are elaborated in the next chapter (see section 3.1). Lefdal (2005) argues that education should enhance the understanding of ethical aspects and presents an overview of relevant topics and design approaches for design and crafts education at the upper secondary level. These include *considerate design*, *design without borders*, *design for life improvement*, *universal design*, *ecological design* and *user-centred design.*[17] Furthermore, Orheim and Nielsen (2017) discuss the teaching of textile manipulations to promote mending and redesign among youth.

Lutnæs (2015a, 2015b, 2017, 2019) contributes to the field with her studies of the potential for enhancing *critical thinking and creativity* for the development of sustainable societies. Lutnæs (2015a) analyses the scientific discourse on creativity in conference papers, refers to her previous fieldwork on art and crafts teachers' assessment of creativity and discusses assessment repertoires and desired learning outcomes on creativity for the solution of real-world problems which empowers citizens to promote sustainability. Moreover, Lutnæs (2015b, 2017) reviews key texts on reflective inquiry, identifies four common phases of reflective inquiry and combines these with methods from systems-oriented design to develop a framework to enhance awareness on exploitation and skills to rethink and transform patterns of unsustainable consumption culture. The four steps in the framework are *confrontation*, *exploration*,

[17] In Norwegian design med omtanke, design uten grenser, design to improve life, universell design / design for alle, økologisk design, brukersentrert design.

evaluation, and *transformation.*[18] The framework is intended for use in education among youth related to the ESC. In the discussion, I will address this framework (see section 6.3 and 6.3.3). Lutnæs (2019) reviews and analyses texts on design literacy in the context on critical innovation, which I elaborate further in the next chapter (see section 3.1).

In common with the research presented above is the focus on design, crafts and sustainability in Norwegian general education, with researchers providing analysis, constructions or discussions of theoretical frameworks and relevant educational topics for the operationalisation of educational practice and potential experiential learning among students. Nielsen and Digranes (2012) draw attention to the need for research on operationalised educational practice and students' experiential learning, where, until recently, there has been a gap in the research-based knowledge on education in design and environmental sustainability.

2.4. Operationalised educational practices

Operationalised educational practices are investigated in an empirical study on assessment rubrics in lower secondary school, to determine how they value responsible creativity in the subject Art and Crafts (Lutnæs, 2018). Moreover, Løkvik and Reitan (2017) has performed a Classroom Based Action Research project with 6th grade students (age 11) on the making of a tunic in reused materials in combination with conversations about sustainability and the maintenance of a textile product.

Bråten and Kvalbein's (2014) text book for teacher education on material reuse in creative work and crafts education with children and youth is included in this review for its' relevance, although it could be seen as beyond the scope because the authors define the book as outside the context of sustainability. Bråten and Kvalbein describe different motivations for material reuse, and focus on the process of working with reused materials, the qualities reused materials provide to the process or the product, and a framework for artefact analysis to use in the process. They refer to material reuse as upcycling,[19] a use of the term that is also found in texts on professional crafts (Veiteberg, 2011) and contemporary art (Gunnerød, 2014). These descriptions and examples resemble craft-based upcycling (Sung & Cooper, 2015), rather than

[18] In Norwegian konfronterende, eksplorativ, vurderende, transformativ.
[19] In Norwegian oppvinning.

technological or biological upcycling (see section 3.2.3; McDonough & Braungart, 2009, 2013); thus, for clarity, I refer to their work as craft-based upcycling. In the discussion, I will address the framework presented in this book (see section 6.3 and 6.3.2).

2.5. Experiential learning among students

Experiential learning among lower-secondary students, and the operationalisation of educational practice in craft-based DfS in lower-secondary school, are investigated in the empirical studies presented in the three articles of this thesis (see chapter 5). These concern students' perspectives on learning about environmental issues in Art and Crafts as a key issue for the operationalisation of educational practice in DfS (Maus, 2017). The use of experiential learning derived from craft-based design in LCT (Maus, 2019a). Finally, the enhancement of youths' design literacy for sustainability in craft-based design education is addressed (Maus, 2019b). These studies employ the concept design literacy from the perceived domain together with theories on design and knowledge, which are elaborated on in the next chapter. However, the order of the articles reflect a process with students' participation in development of research-based knowledge, from the experiential domain of students' perspectives and learning towards the operationalised domain of educational practice.

By expanding the scope to include the Swedish educational context, I was able to find associated research studies with a different approach than my studies. These works inquire into students' learning on materiality in crafts activities that are considered to contribute to environmental education and they are published in journals that specialise in the field of Environmental and Sustainability Education (ESE) (Hofverberg & Kronlid, 2018; Hofverberg & Maivorsdotter, 2018).

3. Theoretical frameworks

This chapter clarifies the use of theoretical frameworks and terms from three fields of research. This employment of transdisciplinary frameworks emerges from the aim of studying the enhancement of design literacy for sustainability and the research questions of the inquiry. The selected theoretical frameworks from the three fields respond to the different aspects and hold different roles, as visualised in Figure 1.

1) The field of design literacy for sustainability reports on the aim for the students' experiential learning.
2) Design for sustainability (DfS) reports on design practices that are relevant as educational content for the operationalised education.
3) Theory of knowledge reports on the epistemological perspectives on students' development of knowledge through engagement in the operationalised educational practice.

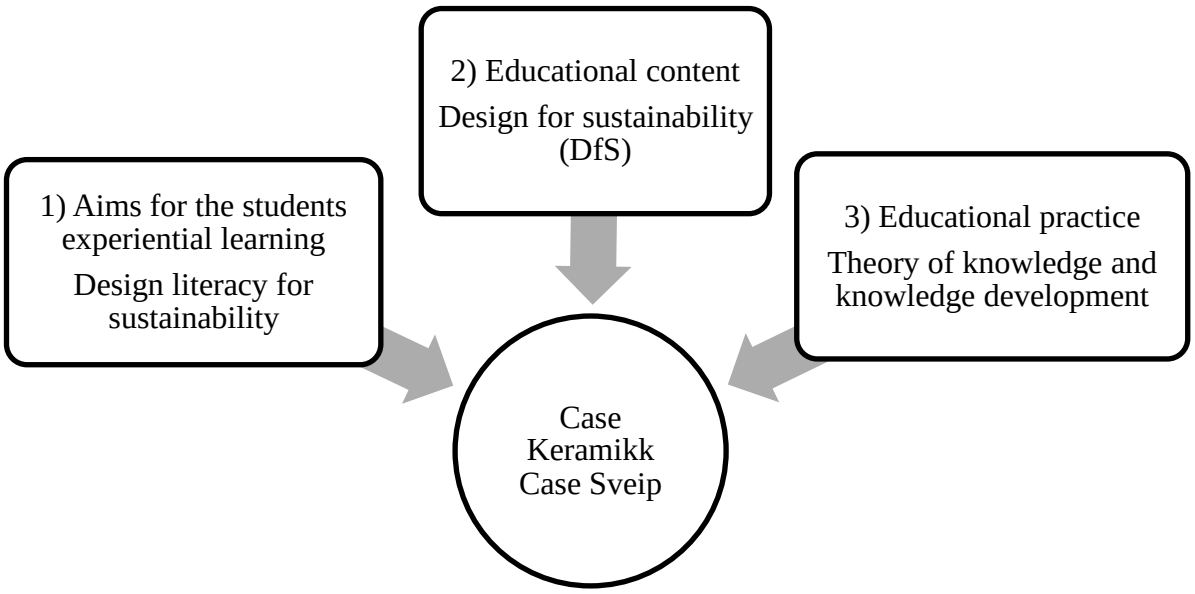

Figure 1: Role of the theoretical frameworks in the two case studies: Case Keramikk and Case Sveip.

3.1. Design literacy for sustainability

In this thesis, design literacy for sustainability refers to the competence to understand and create DfS, with assessment of products' qualities and estimates on their potential environmental impacts and environmentally benign product improvements. This competence encompasses the tools students need to initiate change towards sustainable production and the consumption of

products. The concept draws on Nielsen and Brænne's (2013) description of design literacy as a competence for the understanding and creation of design of products in physical materials in the context of how development of sustainable environments can be supported. They emphasise the development of design literacy through material creation and knowledge in the contexts of purpose, use, production, transport, ecology and ethics. Their aim for the students' development of design literacy is to empower students to criticise and participate in changing the system for production and consumption. I choose to add 'for sustainability' to clearly communicate the context of design literacy I study.

The concept of design literacy for sustainability combines the three terms design, literacy and sustainability: *1) Design* is used as a noun, a verb and an adjective that relates to products and systems and the making and understanding of these (Nielsen, 2008a, p. 25) with the intended 'courses of action aimed at changing existing situations into preferred ones' (Simon, 1996, p. 111). *2) Literacy* refers to a competence compound of skills and knowledge, which enable the ability to understand and use knowledge in context. The concept originate from education in reading and writing, but are today used in a variety of fields (Ongstad, 2014; UNESCO, 2004, 2005b). *3) Sustainability* refers to the context and the aims of preferred situations in ecological, social and economic environments across generations and changes towards sustainable development (WCED, 1987) for responsible consumption and production patterns (UN, 2015, para. 12.1.–12.c.). Design literacy concerns the competence acquired through design education at the general and professional levels (European Design Leadership Board, 2012, pp. 67–71).

The design literacy aimed for in this research project is contained within the context of DfS (see section 3.2). Associated contexts for design literacy discussed in general education include citizenship (Nielsen & Digranes, 2012, p. 18), stance towards inquiry (Christensen, Hjorth, Iversen & Blikstein, 2016; Christensen, Hjorth, Iversen & Smith, 2018) and critical innovation (Lutnæs, 2019). Design literacy is also discussed in professional design education with the focus on innovation (Pacione, 2010) and in industrial design (Clune, 2007). Also closely related is the use in design of ecological literacy linked to how ecological systems function and how products and production process interfere with these (Boehnert, 2013, 2015; Lutnæs & Fallingen, 2017; Stegall, 2006). Other contexts of design literacy mentioned are visual literacy and media literacy (Nielsen & Digranes, 2012, p. 18).

As identified through a literature review and analysis of texts on design literacy relevant for general education (Christensen et al., 2018; Green, 2014; Nielsen & Brænne, 2013), Lutnæs

(2019) derives four narratives towards design literacy and frames a new definition of design literacy in the context of critical innovation. The narratives are: 1) Awareness through making; 2) Empowering for change and citizen participation; 3) Addressing the complexity of real-world problems; and 4) Participating in design processes. The emphasis on the development of awareness through making and addressing the complexity of real-world problems corresponds to the emphases of this thesis. To address this complexity, I employ knowledge from the field of DfS.

3.2. Design for sustainability (DfS)

DfS is a field of research from professional design and professional design education, from which I have selected knowledge on design principles and practices to employ as educational content in the case studies. Here, I have followed the advice of Goodlad et al. (1979, pp. 64–65) of employing similar concepts across the educational system, from professional to general education. Through literature studies, DfS principles and practices in product design were mapped (Sevaldson, 2013), employed, restructured and reduced through the two case studies, to provide this overview of the relevant DfS practices for the students' craft-based designing of products. Embedded in this overview are also ideas on material culture, the potential environmental benefits and limitations of DfS and the contribution these practices make to the youths' experiential learning outcome. Through this work, inspired by the idea of design as redesign (Michl, 2002), design theories are redesigned to develop a new branch of craft-based DfS to support design education for youth.

3.2.1. DfS in product innovation

The design of products to support environmental sustainability is a part of the broad field of DfS that has been developed since the mid-twentieth century to include product innovation, product-service system innovation, spatio-social innovation and socio-technical system innovation (Ceschin & Gaziulusoy, 2016). Research provides descriptions of the development, scope and terms within the field (Bhamra & Lofthouse, 2007; Ceschin & Gaziulusoy, 2016; Keitsch, 2012; Spangenberg, Faud-Luke, 2009; Fuad-Luke & Blincoe, 2010; Skjerven, 2017; Vezzoli & Manzini, 2008; Walker & Giard, 2013). One definition of sustainable design, mirroring these and also the description of sustainable development in the report Our Common Future (WCED, 1987), consists of the following: '. . . taking all ecological, social and economic concerns into account in product and service systems, meeting the needs of the present without

compromising the ability of future generations to meet their own needs' (Keitsch, 2012, p. 189). The term sustainable design can be misunderstood as the design of products that sustain. Therefore, in this thesis, I use the term that underlines design *for* sustainability and design education *for* sustainability. The idea of 'development' from sustainable development is immanent in the term design, which aim to enable positive change (Clune, 2010).

The rhetoric of design products are an essential aspect addressed in DfS. Papanek (1985) criticised designers for valuing glittering consumer gadgets above agricultural implements (Papanek 1985, p. 280). Stegall (2006), on the other hand, suggests a philosophy for ecologically intentional design with a focus on the rhetoric in products' 1) spirit, 2) purpose, 3) form and function and 4) use of resources (Stegall, 2006). The rhetoric of sustainability can also be abused in the greenwashing of products by promoting an environmentally friendly image through selective use of information on the positive and negative sides of the products' environmental and social performance (Lyon & Montgomery, 2013) to reassure consumers that unsustainable consumption is acceptable (Boehnert, 2013, pp. 447, 452, 2015, p. 7) or by minimising the damage of bad design (McDonough & Braungart, 2013, p. 29). In most cases, consumers lack methods for assessing the information about the production of the products they use. Thus, product information can motivate consumers' investigation of corporate claims (Lyon & Montgomery, 2013, pp. 749, 751). General design education holds the potential and responsibility to enhance youths' knowledge, skills and values to be able to evaluate product information, make informed choices and develop their own solutions in favour of sustainable development.

3.2.2. DfS principles: Triple bottom line (TBL) and life cycle thinking (LCT)

Generally speaking, embedding sustainability into the studio experience of design education depends on two principles, the triple bottom line (TBL) and life cycle assessment (LCA) (Giard & Schneiderman, 2013, pp. 129–130). The first principle, TBL, accounts for achievements towards environmental sustainability with environmental quality, social equality and economic prosperity (Elkington, 1999, pp 69–96). In this research project, the second principle is replaced by life cycle thinking (LCT) (Heiskanen, 2002), which concentrates on products' life cycle of raw materials extraction, manufacturing, distribution, use and disposal and the consumption cycle of pre-purchasing activities, acquisition, product use and disposal. In the greater picture, these two life cycles are inseparable, and each presents important agendas for solutions towards sustainability challenges. LCT forms the basis for LCA through the assessment of data on

products' potential environmental impacts for the aim of making product improvements (Cooper, 2005, pp. 55-57, 2010). Because the students involved in this research project were unable to collect or assess such data, I chose to employ the concept of LCT. Heiskanen (2002) accentuates the utility of buyers and suppliers sharing the concept of LCT. I see LCT as a tools students need to initiate change towards sustainable production and consumption of products.

3.2.3. DfS practice for eco-efficiency and eco-effectiveness

The DfS practices selection for this research project is inspired by, and an expanded version of, Cooper's (2005, 2010) model of increased product life span for sustainable consumption, which integrate eco-efficiency and slow consumption (Cooper, 2005, pp. 54–55, 2010, p. 14). I have organised this as the two overarching DfS practices for *eco-efficiency* and *product durability* (Table 1).

I will start with DfS for: 1) *eco-efficiency* with low use of resources throughout the product's life cycle from cradle to grave, from raw materials extraction to product disposal (Cooper, 2005). This practice was expanded with the similar, but not equal, 2) *eco-effectiveness*, which features circular use of resources from cradle to cradle including material recycling from disposed products. In this cradle-to-cradle approach, the design of the product qualities ensures safe technological or biological recycling of resources. Design that obstructs recycling causes loss and thereby downcycling of resources, while design that improves recyclability and adds resources such as energy upcycle resources (McDonough & Braungart, 2009, pp. 45–117; 2013, pp. 14–49). Eco-efficiency and eco-effectiveness practices are based on the principles of LCT, and LCA are often used during the process. Driven by a linear economy, design for linear use of resources from cradle to grave (extraction to disposal) results in loss of resources; reducing this tendency requires a movement towards design for circular use of resources from cradle to cradle (extraction to reuse) driven by a circular economy (Cooper, 2005, p. 52). However, the present state of technology, products and systems for production and recycling is not able to implement recycling of all products and circular use of all resources. Therefore, the practices of both eco-efficiency cradle to grave and eco-effectiveness cradle to cradle were employed in this research project.

Several have pointed out the challenges embedded in the ideas of eco-efficiency and eco-effectiveness. These include the possibility of reduced biodiversity due to the use of chemical pesticides in production (Carson, 1962). Moreover, there is the risk of unforeseen and hazardous results from the reactions of chemicals in recycling, which reduces products' recyclability.

Therefore, the need for regulation in the use of chemicals to secure safe, circular use of resources is strongly argued (McDonough & Braungart, 2009 pp. 53–63). An additional concern is that the idea of efficiency that drives eco-effective use of resources can lead to 'green growth' with product replacements, rapid resources throughput in the user phase and overall resource loss (Cooper 2005, p. 55). While economic growth is related to the sustainability aim of poverty reduction and social equality, the possible limits to growth have also been discussed (Meadows, Meadows, Randers & Behrens III, 1972). Some argue that economic growth cannot necessarily be united with sustainability in an ecological system (Boehnert, 2015, pp. 7–9).

3.2.4. DfS practice for product durability

The second selected DfS practice is product durability and longevity, which here includes designing for: 1) *Intrinsic product qualities*, such as resistance to wear, reliability, upgradability, high-quality materials and robust, carefully assembled and easily repairable construction; 2) *Outer aesthetic qualities*, such as materials that age with dignity, signs of quality and details like in handcrafted products (Cooper, 2005, pp. 61–63, 2010, p. 8); 3) *Functional product qualities* for physical functionality and needs for functional tools and utility products (Stahel, 2010); and 4) *Emotional durability*, with a focus on the subject-object/user-product relationship. Emotionally durable products can be categorised as meaningful tools (the object enables meaningful activity), meaningful association (the object carries significant meaning) and living objects (emotional bonds between an individual and an object, such as enhanced through gifts and memories) (Chapman, 2010, 2015, pp. 42–47). Approaches to design for emotional durability include design for user experience of narratives, detachment, surface, attachment, fiction and consciousness in engagement with products (Chapman, 2015, pp. 174–176, 2009). For living objects, I find examples in the case studies of this research project (Maus, 2019a, 2019b).

One challenge that design for product durability aims to reduce is product obsolescence. The challenges with growth, the throwaway spirit and planned obsolescence were put on the map by Vance Packard in his book *The Waste Makers*, and he suggested restoring pride in prudence and quality (Packard, 1960). Later research has defined multiple causes for products being discarded as obsolete (Cooper, 2010, pp. 14–19), including: 1) functional obsolescence, 2) qualities of obsolescence with aesthetic qualities and 'broken' qualities, 3) psychological obsolescence with changes in fashion, changes in personal style, 'Diderot-effect' with chain reaction of product replacements and hedonism, with indulgence in shopping and 4) changing

consumer needs obsolescence[20] (Strandbakken, 2007, p. 13). However, design for product durability, driven by the idea of *sufficiency*, aims for slow consumption, which can lead to the challenge of an associated recession. While a recession in product consumption supports ecological sustainability, achieving product durability will require a shift towards craft-based production and systems for services such as repairs and maintenance to provide employment in an economical and socially sustainable manner. Taking into account the complexity of ecological, social and economic sustainability, product design strategies based on both efficiency and sufficiency are needed to develop products with long and sustainable lifespans (Cooper, 1997, 2005, pp. 54–63).

DfS practices					
Eco-efficiency (Cooper, 2005, 2010)		Product durability (Cooper, 2005, 2010)			
1) Eco-efficiency from cradle to grave (Cooper, 2005, 2010)	2) Eco-effectiveness from cradle to cradle (McDonough & Braungart, 2009, 2013)	1) Outer aesthetic product qualities (Cooper, 2005, 2010)	2) Intrinsic product qualities (Cooper, 2005, 2010)	3) Functional product qualities (Stahel, 2010)	4) Emotionally durable products (Chapman, 2009, 2010, 2015)

Table 1: DfS practices employed in this research project. The selection was inspired by Cooper's (2005, 2010) mode of design for increased product life span for sustainable consumption, which integrate eco-efficiency and slow consumption.

3.3. Theory of knowledge

The epistemological perspectives on knowledge that form the basis of this thesis build on the immanent idea of design literacy for sustainability as a competence to understand and create in a specific context. Consequently, both the design literacy itself, the students' development and the teachers' enhancement of such, include both knowledge and skill. The sustainability context embeds values and aims beyond craft-based designing in the school studio, which requires the

[20] In Norwegian 1) funksjonell foreldelse, 2) kvalitetsmessig foreldelse med estetisk dimensjon, 'i stykker'-dimensjon, 3) psykologisk foreldelse med moteendring og endring i personlig stil, Diderot-effekt og hedonisme (kjøpsglede), 4) foreldelse på grunn av nye forbrukerbehov.

use of the practice of environmental consciousness. Here, I will describe the perspectives on knowledge and knowledge development employed in this thesis.

3.3.1. Practical wisdom based on skills and knowledge

Practises of sustainable design are related to Aristotelian understandings of activity (Keitsch, 2012, p. 181). I relate design literacy for sustainability to Aristotelian thinking on practical wisdom. Aristotle reasoned that the disposition for doing wise actions for the betterment of humankind is a form of practical wisdom, which he called *phronésis*. He argued that this is neither pure theoretical knowledge (*epistémé*) nor practical knowledge (*techné*), as it leads to both considerations and actions. Phronésis is a higher understanding of what is good for humankind, which draws on both practical and theoretical knowledge (Aristoteles, trans. 1996, pp. 61–62; Gustavsson, 2000, pp. 13–18, 2012, pp. 101-102; Kemmis & Smith, 2008, pp. 21–24). Aristotle reasoned that phronésis is rare to see in youth as it derives from experience and takes time to develop (Aristoteles, trans. 1996, p. 65). This argues for a long-term focus on DfS throughout an individual's education, starting with a combination of basic practical and theoretical issues, as conducted in this research project.

3.3.2. Kategorialen Bildung for development of holistic knowledge

As an approach for embedding and balancing the theoretical aspects of DfS in craft-based design practice, this thesis employs in the development, analysis and discussions of the case studies the theory of kategorialen Bildung[21] by the pedagogue Wolfgang Klafki (1927–2016) (1959/2001, 1985/2001). As a foundation for the development of this theory, Klafki laid out a critical analysis of formation theories'[22] single-sided views on the purpose of education as either learning of educational content or development of the student. He argues that the students' learning of educational content and their development depend on each other and evolve together in educational practice (Klafki, 1959/2001). The terms formal and material education from his critical analysis have been used previously to analyse and describe teachers' valuing of creative work (Brænne, 2009, pp. 20–21). I used these terms in my first attempt at

[21] In Norwegian kategorial danning, in English translated Categorical Education
[22] In Norwegian kritisk analyse av dannelsesteorier.

data analysis, but they illuminated challenges rather than possibilities (see section 6.5), and therefore I replaced them with core aspects of the theory of kategorialen Bildung.

Kategorialen Bildung is described as a phenomenon experienced through the unfolding of holistic knowledge. The phenomenon occurs when students' subjective conditions of critical thinking, judgement, will and imagination unite with objects that culturally represent the world, such as classical culture and scientific knowledge. This understanding evolves through engagement with the object. The engagement process opens the subject's general insights and experiences, while the objective opens its general content, clarifying categories as understandable for the subject. Holistic knowledge constitutes a higher unity than a synthesis of subjective and objective conditions (Hohr, 2011; Klafki, 1959/2001, 1985/2001). In the articles I use the term understanding rather than knowledge to reduce the risk of bias, as design literacy includes both knowledge and skills. From this theory I employed three aspects throughout the research project, which are particularly elaborated in Article 1:

First, the students' development of understanding starts in his/her point of view of the educational topics' significance in their past, present and future lives. From thereon, the educational practice must broaden the student's horizon of understanding (Hohr, 2011, p. 167; Klafki, 1959/2001, p. 194).

Second, the educational topics must be exemplified in the situation, incident or item. The exemplary value of the material depends on being both elementary to open the student's subjective critical thinking, judgement, will and imagination and fundamental to open the objective general idea of the topic (Klafki, 1959/2001, pp. 187–193). Here, Klafki draws on Aristotle's conception of general ideas as present and possible to experience in the perceptible (Hohr, 2011, pp. 167–168). In later works, Klafki questions whether 'elementary' and 'fundamental' are relevant terms for describing exemplification, because science also constitutes the subjects' contemporary understandings (Klafki, 1985/2001, pp. 174–175).

Third, educational topics that enhance autonomy in terms of self-determination, co-determination and solidarity are of relevance to the students' present and future lives and prepare them for participation in society and in its development. Among these topics are key contemporary problems such as sustainability and social justice and topics that develop broad interests and skills (Hohr, 2011, pp. 167–172; Klafki, 1985/2001, p. 176).

3.3.3. Knowledge use in reflection in and on action

A result of the case studies in this thesis consists of the complementary role of experience and reflection in development of understanding, which echoes coherent perspectives accentuated by the pedagogue John Dewey (1859–1952) (Dewey & Dewey, 1915) and the philosopher Donald A. Schön (1930–1997) (Schön, 1991). The use of knowledge in reflection in and on action has been elaborated by Schön (1991), who describes how doing and thinking are complementary and frame the concepts of 'knowing-in-action', 'reflecting-in-action' and 'reflecting-on-action' among practitioners. Schön argues that a one-sided focus on a technical rationale with scientific knowledge and use of defined means towards defined ends is insufficient for an education, because knowledge develops while one is making judgements in practice. The case studies in this research project employ reflection on action (Article 2) and reflection in and on action (Article 3) with the use of research-based knowledge on DfS means towards ends of environmental sustainability. However, the approaches in the case studies are discussed in the light of a model based on the theory by Klafki (1959/2001, 1985/2001) rather than Schön (1991) (see section 5.2 and 5.3). The notion on the integrated position of knowledge in craft-based DfS is essential and challenges some traditions in the field of Norwegian education in Art and Crafts at the primary and lower secondary levels, where theory and practice have been seen as dichotomies (Nielsen, 2009, pp. 100–101, 110–111).

3.3.4. Structured knowledge in design practice

In this research project, I employ and develop structured knowledge. In the case studies, I use DfS to enhance students' holistic understanding of the influence between design products and environmental impacts The DfS principles and practices constitute structured knowledge on design to reduce the environmental impacts of products (see section 3.2). Structured knowledge is explained as 'epistemic infrastructure' and models for how boundaries, distinctions, connections and combinations of related issues presuppose each other. The structures reduce complexity to a comprehensible level, but also reduce oversimplicity (Jensen, 2012, p. 175). Structures of knowledge are tools that are demanded among teachers. Their functions are to give an overview that help to combine and use resources of different origins in the future and to organise these in different contexts (Klette & Carlsten, 2012, pp. 80–81). Throughout the case studies, the use of structured knowledge on DfS proved fruitful and resulted in new structured knowledge in two models that can serve as tools for teachers and pre-service teacher students in Art and Crafts (see section 5.1 and 5.2).

3.3.5. Master-and-apprentice teaching and learning

The different frames for professional design education and lower secondary education in craft-based design call for different teaching methods to promote learning. At the professional level and for adult students, this can be a full-time engagement, while for young lower-secondary students, engagement in design and crafts averages a couple of hours per week (altogether 146 hours in 8–10th grade). Clune's (2010) research on education in industrial design describes how a student-centred approach with engagement in the definition of problems fosters deep learning in DfS and should therefore be preferred above a master-and-apprentice approach. For the case studies in this research project, however, the master-and-apprentice approach was chosen, to encounter the students' perspectives of learning craft-based design as the main purpose of their participation in the school subject Art and Crafts, which was identified in Article 1 (see section 5.1).

3.3.6. Task sequencing to promote learning

Edwards' (2015) quadrant model of task sequencing to promote learning was employed in the development of examples for students' engagement in DfS knowledge in Case Sveip (Article 3, section 4.4). The model includes four sequences: 1) *Introduction* of key concepts and modelling of ways to engage with key concepts; 2) *Tightly structured tasks*, which demand engagement with key concepts and ways of enquiring, with formative assessments for learning through self-evaluation against criteria on the knowledge revealed and the strategies employed; 3) *More open tasks*, which enable learners to apply key concepts and ways of enquiring, such as open-ended problem-solving activities involving ambiguity and risk; and 4) *Demonstration of the grasp* of key concepts and ways of enquiring, with a summative evaluation of learning. The academic task defines the students' work and regulates the selection of information and strategies for processing the information. Edwards emphasises the learners' sense of security in the engagement and writes that poor teaching often is characterised by a direct move from 1 to 4. *The evaluation* of learning from activities that combine instructions, use of memory and open-ended use of knowledge should focus on the learners' ability to enquire, apply and engage with key concepts in structured and open activities (Edwards, 2015). The first two sequences of introduction and tightly structured tasks were used for the master-and-apprentice approach of craft-based DfS.

3.3.7. Education for democracy

In education for the enhancement of design literacy, one aspect is essential to keep in mind. That is, it is challenging to educate individuals for democratic participation through learning of knowledge, skills and values. Professor of Educational Theory, Gert J. J. Biesta (2006), writes that we cannot know how people choose to use their knowledge. Based on an elaboration of individualistic, social and political conceptions of such a 'democratic person' as presented in works by Kant, Dewey and Ardent, Biesta concludes that education must avoid taking an individualistic and instrumental approach towards the development of democratic persons. Rather, education must create opportunities for individuals to be active and experience participation in a world of plurality, in a way that their action does not obstruct opportunities for others (Biesta, 2006, pp. 117–145).

Hence, education for democratic participation in sustainable development must create opportunities for individuals to be active in craft-based design that secures sustainable environments with opportunities for others across the school studio as well as geographical borders and generations. Biesta's descriptions seen in light of the process of implementing sustainability ideology in craft-based design education and research (see chapter 2) also argue for creating opportunities for individuals to be active in the development of the field. This notion sets premises for the choices of research methods.

4. Methodology

This chapter describes the methods used in this thesis and the methodology on which the research has been constructed with related immanent ontological questions on the role and positioning of myself as the researcher in the development of knowledge in this research.

4.1. Ontological and epistemological perspectives

The topic of the inquiry for this thesis requires ontological and epistemological perspectives that, respectfully, encompass the differences in the fields of knowledge employed.

4.1.1. Design educational study with an inter- and transdisciplinary topic

This thesis investigates issues that are inter- and transdisciplinary (Sinnes, 2015, pp. 38; UNESCO, 2018, p. 35) and cross-curricular in school. As an educational topic, DfS principles and practices for sustainability in ecological, social and economic environments transfer and integrate knowledge from a broad spectre of fields of research. In lower secondary education, these fields form the foundation for the curricula in different school subjects. Also, as an educational topic in lower secondary school, DfS knowledge is used in a transdisciplinary manner across general and professional design education. In the research, I also combine DfS with the theory of knowledge in interdisciplinary models of the educational practice on the topic (see chapter 5). Kleve and Penne (2012) emphasise that cross-curricular work in education requires an understanding of and a respectful approach to the fundamental challenge of the differences among the subjects involved (Kleve & Penne, 2012). These differences include in the epistemology, research methods and concepts of evidence and validity in the research results of the different fields. To provide a holistic and respectful approach, I have conducted the inquiries with ontological and epistemological perspectives that acknowledge the complexity of inquiry for the development of education in DfS.

4.1.2. Critical realism as the epistemological perspective

This thesis takes an ontological perspective concerning existence and epistemological perspectives concerning knowledge, which are related to critical realism. Critical realist perspectives are initiated by the English philosopher Roy Bhaskar (1944–2014) (1998, 2008) in his philosophy of science called transcendental realism. These perspectives explain causality in terms of tendencies and generative mechanisms (Alvesson & Sköldberg, 2009, pp. 39–49; Næss, 2016).

Næss (2016) elaborates on critical realist ontology concerning causality in built environments' influence on inhabitants. Objects' properties enable them to exercise certain influences on other objects and make them liable to influences from other objects. Different causal powers operate simultaneously, while the classifications of the causal influence between these is a social construction (Næss, 2016). This perspective can help us understand the educational topic of DfS. Between products and environments, a bidirectional influence operates. Products influence environments by using natural resources, while environments influence the design of products through the materials they provide for the product. By valuing environmental considerations and altering the product's design, the designer also affect the influence between products and environments. The explanations provided by DfS theories for object properties that reduce a product's negative direct or indirect environmental impacts, or increase positive environmental impacts, help us understand this bidirectional influence, although these theories are incomplete.

The epistemology of critical realism is a perspective found within educational action research on and for development. Critical realism argues for an objective reality that we can access through our knowledge of it. This knowledge is imperfect and incomplete, but we constantly improve it through identifying factors and creating explanations. Critical realism indicates that we can make choices leading to improvement in practice and understanding, in an infinite, never-ending process. Our understanding develops through social interaction within the set of structures, practices and conventions that constitutes society (McKernan, 2008, pp. 129–130). Action research also provides pragmatic epistemological perspectives on the practical context as an entity of meaning and learning; moreover, critical epistemological perspectives on democratic participation in transformation (Hiim, 2016, pp. 156–159). I employ methods of educational action research from these perspectives on the infinite development of knowledge through inquiries into two case studies where models and other results from the first influence the development of educational practice in the second and the discussions of these in the articles and this synopsis (see section 5.4 and 6.3).

4.2. Mixed methods: Action research and interviews

This research project employs a mixed-methods approach, in correspondence with the description that it 'mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study' (Johnson & Onwuegbuzie, 2004, p. 17). This research combines the two qualitative methods of semi-structured group

interviews (Brinkmann & Kvale, 2015; Fontana & Frey, 2008; King & Horrocks, 2010; Kvale & Brinkmann, 2009) and action research (Hiim, 2016; McNiff, 2013, 2014) with inspiration in educational action research for improvement and change (Elliott, 2007; Hiim, 2016; McKernan, 2008; McNiff, 2013, 2014; Stenhouse, 1975). Through these methods, the data are constructed, rather than collected (Alvesson & Sandberg, 2018; Maxwell, 2010, p. 478). Moreover, the thesis combines the theoretical-deductive and empirical-inductive approaches in the analysis and interpretations. The mixed method was selected because the thesis comprises inquiry at the perceived, operationalised and experiential levels of educational practice. The operational and experiential levels are uncharted territory, where mapping is required before any theory can be constructed (Goodlad et al., 1979, pp. 58–65). This thesis searches educational practices with the potential for development to enhance experiential learning in DfS through the empirical-inductive approach of semi-structured group interviews among students. However, holistic knowledge develops in encounters between individuals' subjective knowledge and the objective knowledge represented in the field of knowledge (Klafki, 1959/2001). Therefore, knowledge from the field of DfS was collected through the theoretical-deductive method of literature studies and used as the foundation for the development of an interview guide and analysis in the first case study, Case Keramikk. Furthermore, the results from these interviews and literature studies informed the development, execution and evaluation of educational practice in an action research project in the second case study, Case Sveip. Both the theoretical-deductive and the empirical-inductive approach hold immanent challenges, the former of being speculative and turning on itself instead of on the world it should explain, the latter of being in lack of cumulative evidence of about phenomena (Goodlad et al., 1979, p. 46). The combination of perspectives collected through both approaches aims at moderating these challenges. In this chapter, I will elaborate on the research design and how it addresses the research questions that are investigated in this thesis.

4.2.1. Research questions and their operationalisation

The research questions (Table 2) structure the steps of the inquiry and indicate the approaches for investigation. I will here elaborate on the approaches to operationalise these in the three articles of this thesis. The three subordinated research questions all calls for mixed-methods inquiries, while the main research question require a theoretical discussion of the results of these inquiries. Johnson and Onwuegbuzie (2004) describe how mixed methods make use of induction for discovery of patterns, deduction for testing of theories and abduction for

uncovering and relying on explanations for the understanding of results. The theoretical-deductive approach to theoretical interpretations and empirical-inductive approach to comparisons and correlations were both employed in the work with the qualitative empirical data.

Research questions	
Main research question Which possibilities and challenges are involved in craft-based design education to enhance youths' design literacy for sustainability?	
Research question 1 Article 1	How can the design process for sustainability open students' understanding of Design for Sustainability (DfS) as an educational practice relevant for the purpose of their present situation of creative and practical schoolwork, as well as for their future?
Research question 2 Article 2	What kinds of experiences from making a craft-based design product do the students draw on when asked to reflect on their practices, their products' qualities and the environmental considerations in these? Also, what kinds of environmentally considerate design practices correspond with the students' experiences and therefore potentially can be exemplified in their work?
Research question 3 Article 3	What possibilities and challenges are involved in enhancing design literacy among youth through engagement with DfS principles and practices?

Table 2: Research questions investigated in the articles and the synopsis.

Research question 1 calls for a theoretical-deductive approach, through a theoretical discussion on the solutions to a challenge located in the empirical data. This research question enables an investigation of ideas on educational practice that influences interpretations and approaches to research questions 2 and 3 and furthermore contributes to theory building.

Research question 2 is of an empirical-inductive nature for the comparison of correlation in empirical data with practice descriptions in theory, and furthermore rejection of descriptions

that are incompatible with the empirical data. However, this empirical-inductive approach to data analysis is followed by a theoretical-deductive interpretation of empirical data in light of the matching theories, which provides an in-depth understanding of the significance of the data.

Research question 3 employs a theoretical-deductive approach to the development of interpretive examples for school tasks from practices described in theory. Thereafter, through comparisons of students' responses to tasks and practice descriptions in theory, the empirical-inductive approach enables the study of students' experiential learning.

4.2.2. Research design with two case studies

The research design was laid out as an action research project on the development of an educational project in craft-based DfS. Action research projects with the goal of transformation often follow a group over several years with inquiries performed in sequences of planning, acting, observing and reflecting. The purpose of the planning phase is to identify aspects to investigate and put into practice (Hiim, 2010, pp. 18–21; McNiff, 2013, pp. 54–71). To ensure the quality of the educational project offered to the students, this inquiry was designed with a sequence (sequence 1) of data construction to inform the planning phase for the educational project in the second sequence (sequence 2). Accordingly, the action research consists of two sequences with one case each, as visualised in the figure below (Figure 2). Sequence 1 occurs in Case Keramikk, where literature studies in DfS theories and semi-structured group interviews (Brinkmann & Kvale, 2015; Fontana & Frey, 2008; Kvale & Brinkmann, 2009) were employed to construct knowledge on relevant educational content and educational practice (see section 4.3). This knowledge informed the planning phase of the next sequence. Sequence 2 in Case Sveip consisted of an educational project planned, acted, observed and reflected upon through action research (Hiim, 2016; McNiff, 2013, 2014) (see section 4.4). Thus, for the purpose of development, where results from one method help to inform another method, mixed methods (Johnson & Onwuegbuzie, 2004) were employed. The identification of needs for change is a starting point for the development of action research in education (Hiim, 2016, pp. 152–154). However, the frameworks for publication of data reflect assumptions of cause and effect, linear form and a definite conclusion, which are divergent from the cyclical form of ongoing narrative inquiry in action research (McNiff, 2014, p. 174). Therefore, not all the needs for change located in sequence 1 (Articles 1 and 2) are accounted for in the publication of sequence 2 (Article 3).

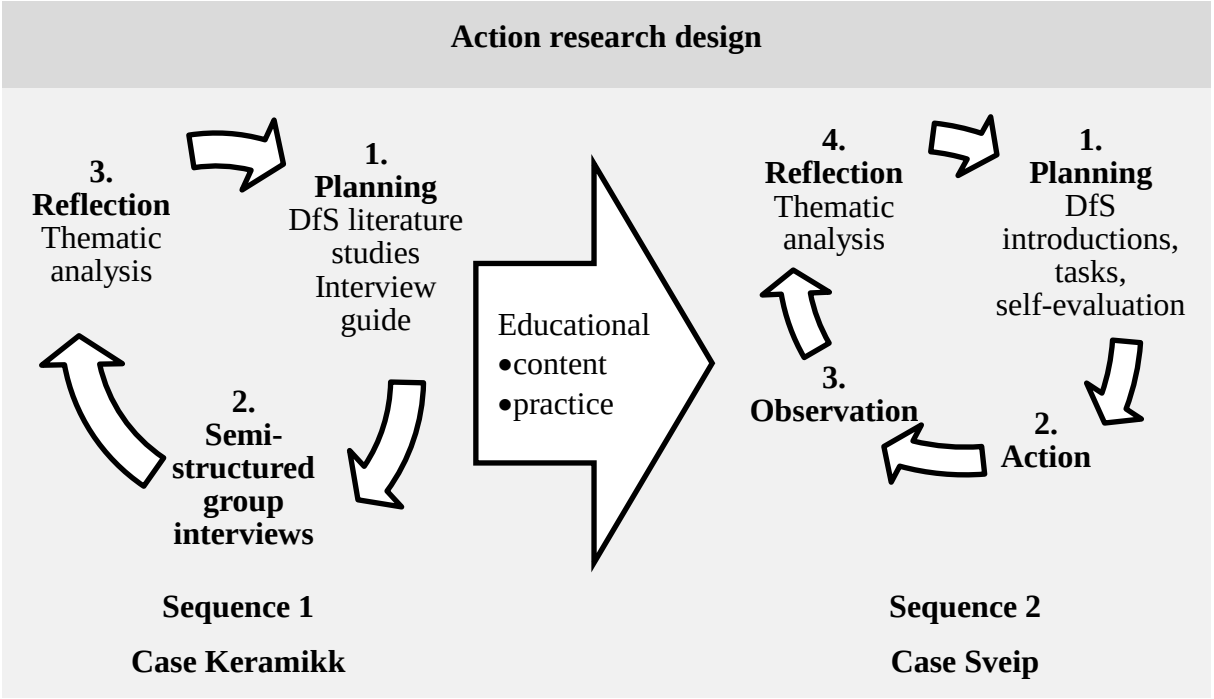

Figure 2: Action research design with two sequences. Sequence 1 refers to Case Keramikk, in which literature studies and semi-structured group interviews are used to identify the relevant educational content and educational methods to inform development Case Sveip in sequence 2.

4.2.3. Recruiting and sampling of school, teachers, students and projects

The two case studies, Case Keramikk and Case Sveip, were conducted in a Norwegian lower secondary school between May 2015 and January 2016. They were conducted in a collaboration between two teachers with subject specialisation in Art and Crafts, herein called June and Tor, their students in the school subject Art and Crafts and I who interacted as the university researcher from Oslo and Akershus University College of Applied Sciences (HiOA).[23]

The recruiting and sampling of this school and these teachers, students and school projects emphasised the compliance with two perspectives. First, the potential for development of design literacy for sustainability through making in physical materials in the context of what supports sustainability in environments (Nielsen & Brænne, 2013, pp. 5–6). Second, the notion that change comes from within (McNiff, 2013, pp. 10–11), so research on and for the

[23] Now OsloMet – Oslo Metropolitan University.

development of educational practice depends upon the school's leaders, teachers and students who want to participate in the development. Recruitment was conducted through information and a request to sign up if interested in further details about participating, presented at two network meetings for teachers that were alumni and practical training supervisors in the school subject. The meetings were held at Oslo and Akershus University College of Applied Sciences (HiOA)[24] in the fall of 2014. From these lists, June was sampled for the focus on facilitating craft-based designing in the school where she works. The schools' administration was contacted in January 2015 and given an invitation asking the Art and Crafts teachers to share their projects on design and sustainability (Appendix 6). Through subsequent meetings, several of the school's teachers were recruited, and finally two school projects taught by June and Tor were sampled. As our working together advanced, the teachers received a second invitation asking them to collaborate in development of their design projects to encompass DfS (Appendix 7). The final meeting when June and I summed up experiences from the project was held in February 2016.

For sequence 1, seven 10th grade students (two males and five females, age 15–16) about to complete their ceramic work in Case Keramikk and their three years with the school subject Art and Crafts at this lower secondary school in May 2015, who had accepted an interview invitation to the students in this project, were sampled (Appendix 8). The possibilities and challenges for engagement with DfS located in their experiences from the craft-based design were drawn upon to inform the planning of sequence 2 with Case Sveip. This was a designing and crafting project for 26 students (twelve males, fourteen females) organised in two groups (of 15 and 11 students) in 8th grade (age 12–13) that were entering the school in the fall of 2015. These students also had accepted an invitation to participate in the research (Appendix 9).

The ceramic works of Case Keramikk that were sampled for sequence 1 and the woodwork of Case Sveip sampled for sequence 2 had several mutual aspects. These include one-semester long projects of designing and crafting a product, challenging crafting techniques that include a permanent change of the character of materials from nature and the making of a digital

[24] Now OsloMet – Oslo Metropolitan University.

presentation (PowerPoint) on the process and product. Case Keramikk included 18 lessons of 3 hours each (total 54 hr, of the total 146 hr of Art and Crafts at the lower secondary level) in ceramic work with designing, modelling, drying and firing of utility objects with ornamental glazing or sculptures of human figure in ceramic clay. Case Sveip included 18 lessons of 90 minutes (total 27 hr) for each of the two groups (total 36 lessons, 54 hr) in bentwood technique, with bending of wood into shapes to make an oval or round box with a lid, bottom and locking mechanism.

4.2.4. Data construction in Case Keramikk and Case Sveip

The research project employed qualitative methods to construct the research data (Alvesson & Sandberg, 2018; Maxwell, 2010), which included semi-structured focus group interviews in Case Keramikk and action research in Case Sveip with a focus on educational development (see section 4.3 and 4.4). Both teachers and students participated in the data construction. An overview of the data constructed and employed in this thesis is presented in the table of the data set (Table 3).

Data set				
Case	**Period**	**Data**	**Participants**	**Use and purpose**
Case Keramikk	May 2015	Two semi-structured group interviews, video recording transcripts • IG1: 58 min • IG2: 70 min	Seven 10th grade students (age 15–16) • IG1: Two females • IG2: Two males, three females	Thematic analysis locating students': • stands towards DfS • use of experiential learning in LCT and correspondence to DfS practices
Case Sveip	August 2015–January 2016	36 lessons (54 hr) observation notes and video recordings: • AG1: 18 lessons (27 hr) with video recording transcripts • AG1: 18 lessons (27 hr)	26 8th grade students (age 12–13) • AG1: 15 students; 7 males, 8 females (principal data) • AG2: 11 students; 5 males, 6 females ('reference' data) • Two Art and Crafts teachers: June and Tor • Two substitute teachers	Time keeping and a thematic analysis of DfS engagement sequences in AG1
	January 2016	24 Project book responses to: • tightly structured tasks • self-evaluation questions	26 8th grade students (age 12–13) • AG1: 15 students; 7 males, 8 females • AG2: 11 students; 5 males, 6 females (2 students did not hand in the project book)	Thematic analysis of students' engagement and experiential learning of DfS in AG1 and AG2
	2015–2016	Log and meeting memos	• Art and Crafts teachers: June and Tor. Two other teachers also attended at a preliminary meeting • University researcher; myself	Documenting participation, contributions and reflections in the action research

Table 3: The data set constructed and employed in this project.

4.3. Semi-structured group interviews in Case Keramikk

Semi-structured group interviews in focus groups (Brinkmann & Kvale, 2015; Fontana & Frey, 2008; King & Horrocks, 2010, pp. 61–78; Kvale & Brinkmann, 2009) were selected as the method for data construction in sequence 1 with Case Keramikk. The interviews were conducted among seven 15-to-16-year-old students, two males and five females in 10th grade in May 2015, when they were about to complete their ceramic project. The interviews were held at their school with their ceramic products present, to reduce the differences between the interview situation and the students' educational situation for which the research project aimed to develop. I will here elaborate on the organisation of the interviews, the interview questions and analysis.

4.3.1. Organisation of the group interviews

Group interviews are the systematic questioning of several individuals simultaneously to enhance their reflections, which are supportive to exploratory studies in new domains (Brinkmann & Kvale, 2015, pp. 175–176; Kvale & Brinkmann, 2009, p. 150). The organisation of the interviews in groups provided both benefits and challenges, which correspond with Fontana and Frey's description of group interviews as cumulative, elaborative and stimulating for recollection, but capable of causing statements of low generalisability due to the potential domination of individuals in the group, which can interfere with others' expressions (Fontana & Frey, 2008, p. 128). Therefore, to ensure a variety of individual perspectives, the interviews were organised into two groups: interview group 1 (IG1), which was composed of two female students, and interview group 2 (IG2), which was composed of five students, two males and three females. Organisation in two groups proved beneficial because tendencies towards the domination of individuals did occur in one of the groups. The groups had uneven sizes and gender balance to fit the students' busy school schedule but provided equally rich material to the study. The interviews were documented through video recordings with a duration of 58 minutes in IG1 and 70 minutes in IG2.

As the experience of organising the students in groups revealed, the interviews in both the groups were characterised by dialog where the students followed up and added to each other's thoughts and statements, and sometimes even interrupted each other's answers to the interview questions. This indicates that the questions and mutual reflections on these helped the students develop their perspectives on the topic, thus the interview answers reflect not only the perspectives of the students entering the interview but also the perspectives they developed

during the interview. This was confirmed by the students during the interviews. Moreover, the results echo Klafki's explanation of the development of understanding as what happens when the subjective aspects of the human and the objective aspects of reality opens towards each other (Klafki, 1959/2001, pp. 192–193). Not adding information that could lead to further learning demanded my attention as an interviewer with a background as a teacher. However, the development of the students' understandings through discussion in the group might also have narrowed their understandings in the direction the discussions were leading. For example, the same topic took the discussions different directions in the two groups, which led to my development of the *Model of educational practice in DfS, variation 1* (see section 5.1). This shows the advantage of interviewing more than one group.

4.3.2. Semi-structured questions

Semi-structured interviews have a research-based focus and employ prepared questions with open-ended answers, while also including improvised elaborative and confirmative questions. These modify the questions for each student (Brinkmann & Kvale, 2015, pp. 160–166; Kvale & Brinkmann, 2009, pp. 134–139) and make the method cumulative, elaborative and stimulating for the recollection and collection of variations in perspectives (Fontana & Frey, 2008, pp. 126–128). Through the prepared questions in the interview guide (Appendix 1) and improvised elaborative and confirmative questions, the students were asked about environmental considerations in their products' design, production and use of materials. The questions were based on the DfS principles of life cycle thinking (LCT) on products' life cycle phases, which include raw materials extraction, manufacturing, distribution, use and disposal (Cooper, 2005; Heiskanen, 2002). Moreover, the triple bottom line (TBL) aims for environmental sustainability, with environmental quality, social equality and economic prosperity (Elkington, 1999). Furthermore, related DfS practices for eco-efficiency with low use of resources cradle to grave (Cooper, 2005, 2010), eco-effectiveness with circular use of resources cradle to cradle (McDonough & Braungart, 2009, 2013) and product durability and longevity (Chapman, 2009, 2010, 2015; Cooper, 2005, 2010; Stahel, 2010). The questions encouraged the students to give descriptions in their own vocabulary, rather than in the technical terms from the selected theories.

This interview design is flexible and proved functional to construct relevant data on the students' use of acquired learning in craft-based design in further reflections on environmental consideration. It resemble problem-based approach to learning on real issues and problems

(UNESCO, 2014a, pp. 64–67). A similar approach to reflections on environmental considerations, whereby students acquire experiences with a phenomenon prior to learning about the phenomenon's theoretical aspects, is described in the literature on Education for Sustainable Development (ESD) and referred to as phenomenon-based education and learning (Sinnes, 2015, pp. 127–129) with references to phenomenology in science education (Østergaard, Dahlin & Hugo, 2008).

These questions are design disciplinary. Nonetheless, the topic of sustainability is also inter- and transdisciplinary, so their responses are likely to encompass experiences from previous school projects in their formal education and non-formal and informal education in their everyday living (UNESCO, 2014a, pp. 20, 30–31), which were not accounted for in this research project.

4.3.3. Thematic, theoretical analysis

A thematic analysis (King & Horrocks, 2010, pp. 142–174) with a theoretical reading (Brinkmann & Kvale, 2015, pp. 269–275; Kvale & Brinkmann, 2009, pp. 235–340) of the video recordings from the interviews was conducted in three stages with several steps:

Stage 1) *Descriptive coding* through familiarisation, transcription, tidying up of overlapping responses, anonymisation of individuals with codes and organisation of the transcriptions in coded analytical units based on the introductory interview questions.

Stage 2) *Interpretive coding* of the units for Article 1 and for use in planning of the action research was conducted with one theme: 1) Educational practice. Moreover, two subthemes were included: 1) Design and crafts and 2) Environmental consideration. *Interpretive coding* of the units for Article 2 was conducted according to three themes concerning the students' products' life cycle phases: 1) Material extraction phase – before craft-based design practice; 2) Production phase – during the craft-based design practice; and 3) Use and disposal phase – after craft-based design practice. Moreover, 11 subthemes on materials, products and production that correspond with DfS practices were included*:* 1) Ecological resources for material extraction; 2) Human resources in the process of material extraction; 3) Effective use of material resources; 4) Health, environmental and security precautions; 5) Production and product value; 6) Functional qualities and products' purpose; 7) Product emissions during use; 8) Emotional qualities of personal belongings and gifts; 9) Outer aesthetic qualities and

craftsmanship; 10) Intrinsic product qualities and solid, repairable constructions; and 11) Safely disposable or recyclable products.

Stage 3) *Defining overarching themes* of three DfS practices that relate to the experiential learning about materials, products and production located in the students reflections on the life cycle phases: 1) Eco-efficiency; 2) Eco-effectiveness; and 3) Product durability.

The inclusion of interpretive coding in subthemes reduces the risk of picking up only aspects fitting the theoretical framework (King & Horrocks, 2010, p. 154).

4.4. Action research in Case Sveip

The qualitative method of action research (Hiim, 2016; McNiff, 2013, 2014) was selected for data construction in sequence 2 with Case Sveip. The action research was conducted in collaboration with the teachers June and Tor and 26 students in two groups: Action Research Group 1 (AG1, 15 students: 7 males, 8 females) and Action Research Group 2 (AG2, 11 students: 5 males, 6 females) in the 8th grade (age 12–13). In action research, actions are taken to improve practice. Claims about the attainment of these improvements are grounded in documentation, analysis and democratic participation (McNiff, 2013, pp. 89–130) with various contributions from the participants (Hiim, 2016). Action research is conducted in action–reflection cycles composed of planning, acting, observing and reflecting on improvements in practice (McNiff, 2013, pp. 56–57, 105–118). This action research comprised four imbricated phases: planning, action, observation and reflection, all of which were documented to show how the study was carried out democratically and the knowledge outcome validated.

4.4.1. The planning phase

In the *planning phase,* June developed a model bentwood box, with assistance from Tor. In addition, June made instructions, learning objectives and assessment criteria. These were enclosed in a project book file in PowerPoint (Appendix 2), together with DfS introductions, tightly structured tasks and open-ended self-evaluation questions that I developed in three stages:

Stage 1) *Definition of four overarching themes*: 1) DfS introductions and tasks (Edwards, 2015); 2) DfS principles and practices (Cooper, 2005, 2010; Elkington, 1999; Heiskanen, 2002; Keitsch, 2012); 3) DfS practices for eco-efficiency and eco-effectiveness (Cooper, 2005, 2010; McDonough & Braungart, 2009, 2013); and 4) DfS

practices for product durability (Chapman, 2009, 2010, 2015; Cooper, 2005, 2010; Stahel, 2010).[25]

Stage 2) *Development of seven interpretive themes* for the introductions and tightly structured tasks with the following project book headings: 1) Design and sustainability; 2) Functional design; 3) Traditional design, unique details; 4) Accuracy in craft; 5) Materials with sustainable life cycle; 6) Construction, repair and maintenance; and 7) Value, price, wages and material costs.[26]

Stage 3) *Development of four self-evaluation questions* on the students' experiential learning with the following project book headings: 1) Difficulties; 2) Usefulness of knowledge on sustainability and design; 3) Problem solving for sustainable design; and 4) Crafts.[27]

The project book texts were in Norwegian, encouraging the students to respond in their own formulation. Technical terms, researchers' names and sources were omitted. During the project book development, June and I maintained an open dialogue; drafts were assessed by June and adjusted accordingly multiple times. In addition, two students assessed the project book before the students' project book work in the last lesson.

4.4.2. The acting phase

In the *acting* phase, from August 2015 until January 2016, AG1 and AG2 each had 18 lessons of 90 minutes (total 27 hr) for a combined total of 36 lessons (54 hr). June taught 27 of these lessons, and Tor taught six lessons as a substitute teacher. Two other substitute teachers taught one and two lessons, respectively. In lessons 1–17, which focused on craft-based designing of the bentwood box in the school studio, DfS was introduced by June and Tor when they found it expedient. In lesson 18, June and the students worked on the DfS introductions and tasks in the project book in a computer room. At no point did I act as a teacher.

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[25] In Norwegian 1) DfB introduksjoner og oppgaver; 2) DfB prinsipper og praksiser 3) DfB praksiser for øko-effektivitet og sirkulær ressursbruk og 4) DfB praksiser for produktholdbarhet.

[26] In Norwegian 1) Design og bærekraft; 2) Funksjonell utforming; 3) Tradisjonell utforming, unike detaljer; 4) Nøyaktig håndverk; 5) Materialer med bærekraftig livsløp; 6) Konstruksjon, reparasjon og vedlikehold; og 7) Verdi, varepris, lønn og materialkostnader.

[27] In Norwegian 1) Vanskelig; 2) Nytte av kunnskap om bærekraft og design; 3) Problemløsning for bærekraftig design; og 4) Håndverk.

4.4.3. The observation phase

In the *observation* phase, the data were documented in three ways:

Data 1) I made video recording transcripts and timekeeping and observation notes of the DfS engagement sequences in AG1 (18 lessons, 27 hr). This data sample had little interference by students that were not participating in the research, and, moreover, represents the similar project progression in AG1 and AG2 that I documented in observation notes and video recordings from all the lessons in both groups.

Data 2) The students recorded their task and self-evaluation responses in their project books (N = 24). Some responses referred to several themes, while four project books lacked some responses. Consequently, the data do not always sum up to 24. Two of the 26 students did not hand in their project books.

Data 3) I made logs and memos from the meetings with the teachers.

4.4.4. The reflection phase

The *reflection* phase involved quantitative and qualitative analysis of the data (McNiff, 2013, pp. 111–112). Thematic coding, which was inspired by thematic interview analysis (King & Horrocks, 2010, pp. 142–174), was conducted in three stages:

Stage 1) *Descriptive coding* by anonymising the data into coded, analytical units.

Stage 2) *Interpretive coding* of the data according to the seven interpretive themes: 1) Design and sustainability; 2) Functional design; 3) Traditional design, unique details; 4) Accuracy in craft; 5) Materials with sustainable life cycle; 6) Construction, repair and maintenance; and 7) Value, price, wages and material costs.

Stage 3) *Organising the data in the four overarching themes*: 1) DfS introductions and tasks; 2) DfS principles and practices; 3) DfS practices for eco-efficiency and eco-effectiveness; and 4) DfS practice for product durability.

Measurability tends to focus on quantity rather than quality in education and learning (Hiim, 2016, pp, 150–151). However, the quantitative results of the timekeeping records and the students' responses should not be read solely from an effect-oriented approach to education; instead, they should be viewed within the qualitative outcomes of the project. The data were limited to the understandings expressed by the students and do not account for additional sources of the students' knowledge on this transdisciplinary topic.

4.5. Validity and validation

The concept of *validity* encompasses questions on the validity, or correctness, of the knowledge produced and the strength of statements, also including the researcher's influence on the research results. Moreover, *reliability* through the consistency and trustworthiness of the research results. Furthermore, analytical *generalisability* on the extent to which the result of one study can guide what might occur in another situation. These aspects are integrated, rather than separate sections, of the research secured through transparency in procedures, producing convincing evidentiary results (Brinkmann & Kvale, 2015, pp. 277–300; Kvale & Brinkmann, 2009, pp. 241–265). The use in this research of mixed methods in the two case studies raises questions not only about the validity of their results, but also on their results' generalisability and contribution to the validity of knowledge regarding the main research question. I will elaborate on some of these main aspects in addition to those accounted for above.

4.5.1. Validity and roles of the participants

In validation of the research results, reflections on the researchers' role and influence on the research results are essential. Particularly in action research with the aim of developing knowledge on challenges and making improvements in practice, claims to knowledge are grounded in documentation of the democratic participation of those involved (Hiim, 2016, pp. 155–156; McNiff, 2013, pp. 89–130). While the distribution of responsibility in the action research has been accounted for (see section 4.4.), here I will elaborate on the topic.

Hiim (2016) uses the terms university researcher and teacher researcher while describing the roles in action research (Hiim, 2016, pp. 154–155). Through terms and descriptions, I will elaborate the roles of the teachers June and Tor and myself in this project. I initiated the action research as the university researcher, an employee at the university who had never met the participating lower secondary students and therefor an outsider to their educational situation, although I knew the participating teachers and lower secondary school as part of my network and am educated as a teacher with subject specialisation in Art and Crafts and have teaching experience from lower secondary level. As a university researcher, I had the administrative and dominant position of defining the basic conditions for the project and the responsibility for ensuring that the project was carried out according to the plan. This included the idea of research topic and choice of methods, which I had concretised in the applications for the funding at the

university and for approval from the Norwegian Centre for Research Data (NSD)[28]. These ideas were developed and adjusted in collaboration with the teacher researchers but could not be changed substantially. Also, I shared knowledge on the research process and new knowledge on potential new educational content, giving the teacher researchers the opportunity to gain new expertise. The teacher researchers ensured that the research project was carried out at the school in an achievable and realistic manner, by providing information on the schools' routines and the teaching plans where the new educational content could fit in. Also, the teacher researchers knew the students, suggested relevant classes for the study and secured a suitable level of differentiation for the educational content. Through collaboration, we rendered possible case studies concerning the embedding of DfS in the school's existing educational practice. The intention was to develop an educational practice, which the teacher researchers and I as the university researcher mutually consider to have good potential.

In encounters with the students, I acted as an interviewer in Case Keramikk and as an observer in Case Sveip. At no point did I act as a teacher in Case Sveip, but I informed the students about the research project and responded when they talked to me. As an observer it was not my position to intervene in the educational practice, but I did so in two situations. In one situation, I made a student aware of having glued a wooden part in the wrong position, so the student could correct the error before the glue dried and ruined months of woodwork. As an educated teacher in Art and Crafts, I found it difficult to omit making the student aware, and not doing so could also have damaged the student's trust in me and jeopardised the future data collection in the group. In another situation I interrupted the teacher June's guidance of one student to inform her that another student was playing dangerously with sharp tools behind her back, putting other students at risk. I consider it unethical for any adult to by stand during such an incident.

4.5.2. Reliability of the knowledge

The *reliability* consistency and trustworthiness of the research results depend upon the documentation of how the study has been carried out, to prove that the process has been democratic and to secure evidence that will lead to the results of the study, which hold claims

[28] In Norwegian Norsk senter for forskningsdata (NSD).

to the knowledge produced through the study. These include monitoring the practice, gathering data and generating evidence (McNiff, 2013, pp. 104–118).

Documentation in the form of video recording transcripts from both the semi-structured group interviews and the action research provided details useful to the analysis. For example, while some of the students in Case Keramikk expressed concerns that the topic of environmental considerations would disrupt the practical work, documenting the timekeeping of the video recordings showed the exact time spent on the DfS conversations in both cases (see section 5.1, 5.2 and 5.3). In addition, the transcripts of the video recording documented that the details in the DfS introductions and tasks coincided with situations in the practical work (Article 3). Moreover, how the students made use of design knowledge in their responses to the questions on the environmental considerations of their products (Article 2). Furthermore, how the students expressed an understanding of DfS in conversation, which in Case Sveip coincided with their expressed understanding in their project book responses to tightly structured tasks but not entirely with their self-evaluation responses on their experiential learning (Article 3). This last result required comparison of the video recording transcripts with the project book responses. Not everyone is comfortable speaking on tape, but none of the participants in these case studies expressed that they experienced the video recordings as uncomfortable. The log and memos from meetings with the teachers documented the different contributions and reflections, including the teachers' evaluations after the project in Case Sveip (Article 3). Hiim (2016) emphasises the contribution of the teachers' professional knowledge.

McNiff (2013) emphasises how critical readers contribute to testing the validity of the results (McNiff, 2013, pp. 133–144). As a PhD student and candidate writing an article-based thesis, plural critical readers have provided me with valuable feedback on my texts. These include first-year-seminar, midway-seminar, ending-seminar and text-seminar participants of the PhD programme, as well as of seminars and the master-class at The Norwegian National Graduate School in Teacher Education (NAFOL). Other critical readers were colleagues and supervisors in the Design Literacy research group. And finally, I benefited from critiques by editors and blind peer reviewers in journals and the publisher of my articles. The responses from these readers have induced me to re-analyse data and rewrite article drafts, thereby contributing to the reliability of the results and outcomes.

The results of the analysis include the students' expressed experiential learning. However, the educational practice cannot be singled out as the only source of the students' learning, because the development of knowledge is an ongoing process influenced by numerous sources.

The topic of sustainability is part of the discourse in society and a cross-curricular topic in education. Thus, the views expressed by students on experiential learning in these case studies are possibly also influenced by other experiences in their formal education at school, non-formal education at museums or informal education from channels such as product producers, waste management and media (UNESCO, 2014a, pp. 20, 30–31).

4.5.3. Generalisability of the knowledge

The analytical generalisability of developed knowledge concerns the judgements about whether and to what extent the results of one study can guide what might occur in another situation (Brinkmann & Kvale, 2015, pp. 295–300). With the employed research design, one case study informs the next. The differences and similarities affecting how these can inform each other are accounted for in the section on recruiting and sampling (see section 4.2.3). The foremost generalisability of and between the results of these case studies is embedded in the models developed through analysis of the data (see chapter 5). The *model of educational practice in DfS* was developed in Article 1 and the *Model of LCT in craft-based design* was developed in Article 2. The potential use of the model from Article 1 was concretised in the discussion of Article 2 and 3 and in this synopsis. Furthermore, the rich data descriptions in Article 2 and 3 as well as the cluster column chart in Article 3 contextualise the knowledge embedded in these models.

4.6. Ethical considerations for participants

The research was performed with the consent of the teachers, the students and their parents and approval of the NSD (2019; Appendix 3–9). Moreover, in correspondence with the directions on ethical aspects of the national guidelines for research ethics (National Committee for Research Ethics in the Social Sciences and the Humanities [NESH], 2016).

The process of receiving responses on the request for participation in the research project from the parents took some time. The school distributed the information and request to the parents through e-mail, which was the media through which they had received the most replies. Still, several parents needed reminders to respond, and some parents responded through text messages. A phone call to the NSD confirmed that SMS is a valid form for consent.

Four students in the groups of the action research in Case Sveip did not participate in the study; one choose not to, while from the parents of three students we never received consent. These students participated in the educational practice, but not in the data material used in the analysis. To reduce the risk of capturing these students on the video recordings as they moved around in the school studio, the video camera was often turned away only collecting audio of the situation. This made the research project more dependent upon the quality of the observation notes, and it shaped the data collection. In the analysis, this dependence on observation notes proved beneficial as my observations of all sessions of interest are noted.

In a phone call to the NSD on the matter, this was chosen as the best approach. As the senior advisor at the NSD explained, action research in schools exists at the border of what it is possible to ask participant consent for. As the school has decided to make certain changes and these are being tried out in their compulsory class through action research, the students cannot avoid being part of the project even though no data are being collected about them. However, being part of the development in educational practice is part of their life at school.

All participants, except myself, are anonymised, to protect the individual students in the sampled school classes. Unavoidably and unfortunately, the anonymisation deprives the participants of deserved credit (McNiff, 2013, pp. 112–113), which in this case includes the teachers, the students, the school administration and the consenting parents. As part of the anonymisation, photos of the students' craft-based design products showing unique details were not included to avoid recognition. However, a photo of a model made by the teacher called June is included in Article 3.

Studying educational activity includes studying the cooperation with teachers and students in their working process. This study does not contain any sensitive information such as health conditions, ethnic background or political or sexual orientation of the persons involved. Still, having someone register information on oneself can be experienced as sensitive. Participation in this, as in other research projects, is voluntary, and the participants have the possibility to withdraw from the research project at any time, without giving an explanation.

5. Results and integration of results

This chapter presents the three articles included in this thesis, with a short summary of their research questions, results and theoretical stances. Section 5.4 provides an overview on how the results are integrated across the inquiry (Table 4).

5.1. Article 1: The Model of educational practice in DfS

Maus, I. G. (2017). Developing holistic understanding in design education for sustainability. In A. Skjerven & J. B. Reitan (Eds.), *Design for a sustainable culture: Perspectives, practices and education* (pp. 157–170). Abingdon, UK: Routledge. URL: https://www.taylorfrancis.com/books/e/9781315229065/chapters/10.4324/9781315229065-12

Article 1 concerns students' perspectives on learning environmental concerns in Art and Crafts as a key issue for the operationalisation of educational practices in DfS. The article is an inquiry on the research question: *How can the design process for sustainability open students' understanding of Design for Sustainability (DfS) as an educational practice relevant for the purpose of their present situation of creative and practical schoolwork, as well as for their future?* The interconnectedness between students' experience of relevance and development of understanding was a core aspect of this study. I identify and employ two diverging viewpoints among students in Case Keramikk on the topic of environmental concerns as either useful in design and crafts or a disruptive topic that will shift the educational practice towards theoretical work. Furthermore, I employ the theory of *kategorialen Bildung* (Klafki, 1959/2001, 1985/2001) and DfS in the study (see section 3.3.2 and 3.2).

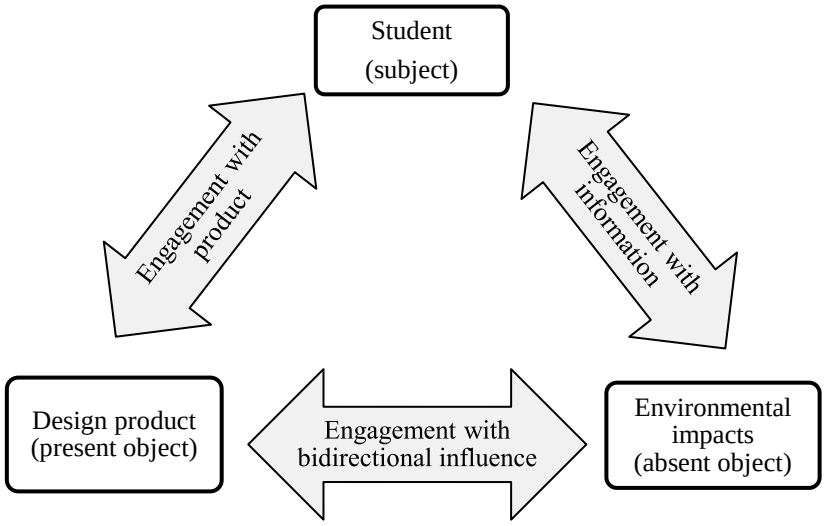


Figure 3: The Model of educational practice in DfS, variation 1 (Maus, 2017, p. 164).

The *Model of educational practice in DfS, variation 1* (Figure 3, Maus, 2017, p. 164) can be seen as being a result of this study. The model outlines, as a triangular figure, the students' engagement with the objects of educational material that exemplify in situations, incidents or items the educational topic DfS. The student (subject) engages with the design products (present object) that are present in the school studio, the information on the products' potential environmental impacts (absent object) that are absent from the school studio and the bidirectional influence between these. Through DfS practice in the school studio, the item of the students' design product and the situation of the production process can be exemplified, experienced and improved to reduce the products' negative environmental impacts. This DfS practice can open the students' understanding of environmental concerns as not only comprehensible, but also relevant for their present situation of creative and practical schoolwork, as well as for their future. The DfS process brings purpose to the educational topic of environmental concerns in design education.

5.2. Article 2: The Model of LCT in craft-based design

Maus, I. G. (2019a). Developing design literacy for sustainability: Lower secondary students' life cycle thinking on their craft-based design products. *FormAkademisk – Research Journal for Design and Design Education, 12*(1), 1–18. DOI: https://dx.doi.org/10.7577/formakademisk.1725

Article 2 concerns students' development of design literacy for sustainability through LCT on their craft-based design products. This article addresses the research question: *What kinds of experiences from making a craft-based design product do the students draw on when asked to reflect on their practices, their products' qualities and the environmental considerations in these? Also, what kinds of environmentally considerate design practices correspond with the students' experiences and therefore potentially can be exemplified in their work?* A core aspect was the location of correspondence between the students' experiential learning used in LCT and established DfS practices, because these can exemplify DfS in both objective and subjective terms with a starting point in the students' perspectives on their product.

The *Model of LCT in craft-based design* (Figure 4, Maus 2019a, p. 3) and the extensive thematic data analysis of students' LCT on their ceramic products in Case Keramikk can be seen to be a result of this study. The students' engagement in LCT took approximately 1 hour, which is 1.8% of the time in this ceramic project. The model presents the students' LCT on their craft-

based design products' three life cycle phases: 1) Material extraction phase before craft-based design practice, 2) Production phase during craft-based design practice and 3) Use and disposal phase after craft-based design practice. In this LCT the students use experiential learning from making their craft-based design products that corresponds with, and has potential as examples for, engagement with:

a) DfS practices in the production phase, including eco-efficiency with low use of resources, eco-effectiveness with circular, safe use of resources and design for the durability of emotionally valuable personal belongings.
b) Distinctive characteristics of materials, products and production decisive for DfS practices in the phases of material extraction and use and disposal. These include eco-efficiency with low use of resources, eco-effectiveness with safe, circular use of resources and design for product durability through functional, emotional, aesthetic and intrinsic product qualities in decorative artefacts, personal belongings and gifts.

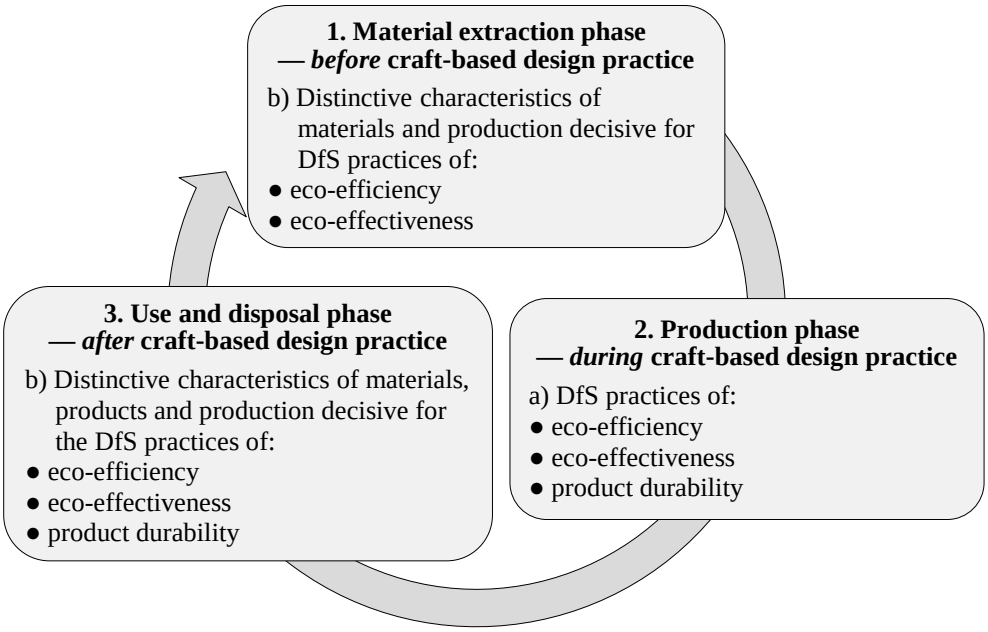


Figure 4: The Model of LCT in craft-based design (Maus, 2019a, p. 3)

The *Model of educational practice in DfS, variation 2* was developed for the discussion of these results. This model visualises the students' engagement with the DfS principles of life cycle thinking (LCT) and triple bottom line (TBL) aims, moreover design for sustainability (DfS) practice in craft-based design (Figure 5, Maus 2019a, p. 10). Through the discussion, I find that LCT in craft-based design encompasses possibilities of enhancing students' design literacy for

sustainability, which strengthens their ability to participate in the democratic development of sustainable production and consumption as well as the development of their own education.

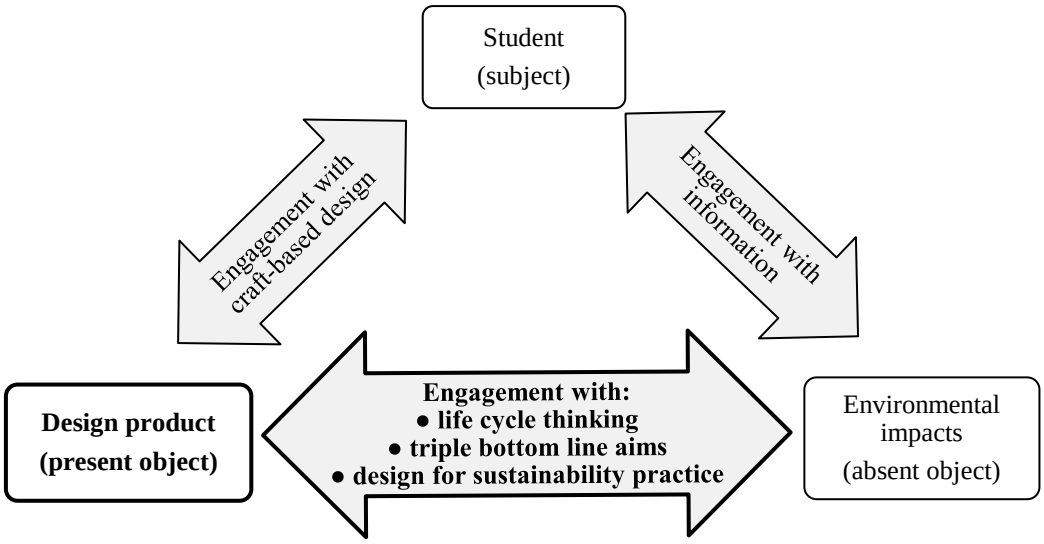


Figure 5: The Model of educational practice in DfS, variation 2. The bold text marks the focus of this study: students' engagement with LCT, TBL aims and DfS practice (Maus 2019a, p. 10).

5.3. Article 3: Introductions and tasks in craft-based DfS

Maus, I. G. (2019b). Enhancing design literacy for sustainability among youth in crafts-based design education. *Techne Series – Research in Sloyd Education and Craft Science A, 26*(1), 93–108. URL: https://journals.hioa.no/index.php/techneA/article/view/2851

Article 3 concerns operationalised educational practice in, and students' experiential learning of, craft-based DfS. This article addresses the research question: *What possibilities and challenges are involved in enhancing design literacy among youth through engagement with DfS principles and practices?* The inquiry involves an educational project in craft-based DfS, where core aspects were to locate the correspondence between the educational practice, the students' engagement with introductions and tasks and their expressed experiential learning.

The results encompass possibilities for enhancing students' design literacy for sustainability with experiential learning of DfS as comprehensible and relevant. Through action research in Case Sveip, examples on DfS principles (i.e. LCT and TBL) and DfS practices (i.e. eco-efficiency, eco-effectiveness and product durability) were embedded in the craft-based design of bentwood boxes. DfS was introduced during the bentwood work and in an associated project book with introductions, tightly structured tasks and self-evaluation questions on experiential

learning. The students used approximately 7.5% (2 hr) of the time on DfS introductions and tasks (i.e. 1.9%, 29 min, during decision-making situations about the design in sketches, work drawings and material selection and 5.6%, 90 min, during assessment of their products in their project books), while 92.5% (25 hr) was used on the bentwood work. According to the self-evaluation responses (N = 24), the majority (n = 16) of the students found nothing in the project they did not understand or manage, and none responded that DfS was difficult. Also, the majority (n = 17) found that knowledge on DfS would be useful in their design and craft practices in general or in their present and future education or professional life, and some (n = 3) mentioned in sustainable consumption.

The results also encompass challenges of enhancing students' design literacy within DfS practices for product durability. The students' self-evaluations indicate that they were further along in their development of design literacy in DfS practices for eco-efficiency and eco-effectiveness, which the majority (n = 17) associated with learning DfS, than for product durability, which they associated with learning craft. The explanation for this difference could not be found in the project documentation, thus I discuss whether this result can be attributed to the distinct characteristics of DfS practices. By structuring these on the *Model of educational practice in DfS, variation 3* (Figure 6, Maus, 2019b, p. 103), I visualise how design for eco-efficiency and eco-effectiveness aims to reduce products' direct environmental impacts, while design for product durability aims to reduce indirect environmental impacts from product replacement and disposal. In the discussion, I employ the concept of subject-object relationship (Chapman, 2010, 2015), which I expand with the concept of object-object relationship.

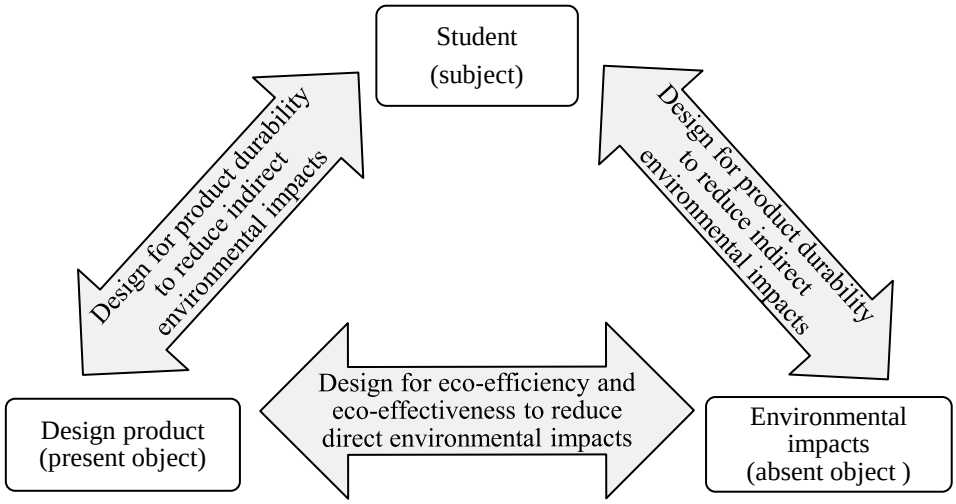


Figure 6: The Model of educational practice in DfS, variation 3 (Maus, 2019b, p. 103), on engagement in design for product durability versus eco-efficiency and eco-effectiveness.

5.4. Integration of results across the articles

The results of the inquiries in Case Keramikk (Articles 1 and 2) and Case Sveip (Article 3) have been integrated across the articles as the project has developed. In particular, the *Model of LCT in craft-based design* (Maus, 2019a, p. 3) and the variations of the *Model on educational practice in DfS* (Maus, 2017, p. 164, 2019a, p. 10, 2019b p. 103) and two extended thematic analyses include possibilities and challenges that have been identified and further integrated. The models' relevance for the further use indicate their generalisability, thus validating that these can be viewed as main results of the inquiries. An overview of the integration of findings is presented in Table 4.

Articles	**Results**	**Integration of results**
1) Developing a holistic understanding in design education for sustainability.	• *Model of educational practice in DfS*, with engagement in examples of the bidirectional influence between design products and environmental impacts.	• Define focus on DfS principles and practices in craft-based design for articles 2 and 3. • Variations of the model structure discussion of the results in articles 2 and 3.
2) Developing design literacy for sustainability: Lower secondary students' life cycle thinking on their craft-based design products.	• *Model of LCT in craft-based design*, with students' use of experiential learning that corresponds with DfS practices.	• DfS principles and DfS practices corresponding to the students' experiential learning employed in Article 3.
3) Enhancing design literacy for sustainability among youth in crafts-based design education.	• Possibilities of enhancing design literacy for sustainability with experience of DfS as comprehensible and relevant. • Challenges of enhancing design literacy for sustainability in DfS practices for product durability to reduce indirect environmental impacts.	

Table 4: The main results and their integrations across the articles.

6. Discussion and conclusion

In the previous chapter, I have presented the main results with the *Model of LCT in craft-based design* and the variations of the *Model on educational practice in DfS,* which contain the possibilities for and challenges to students' engagement in the DfS principles and practices located throughout this research project. In this chapter, I will discuss how the results from this research project respond to the main research question: *Which possibilities and challenges are involved in craft-based design education to enhance youths' design literacy for sustainability?* I will also discuss how these results contribute to the field of research. First, however, I will briefly revisit the starting point of this inquiry to state the position in the field to which the results of this research project contribute.

6.1. Knowledge on operationalised and experiential DfS

This research project started with the need for research-based knowledge on the development of Norwegian design and crafts education for youth within the ESD aims of encompassing the of principles, practices, knowledge, skills and values for sustainable development (UNESCO, 2005a, 2014a), to support research-based education for Specialised Teacher Training in Design, Art and Crafts. A reading of the related research through the framework for curriculum inquiry (Goodlad et al., 1979) identified an implementation process of ESD ideology with international and national policies and the formal curricula, with the research focusing on the researchers' perceptions and use of theoretical-deductive approaches. This further reveals a gap in the research-based knowledge developed with the use of the empirical-inductive approach, concerning the operationalisation of educational practices and the students' experiential learning, the field to which this research project contributes and supplements (see chapter 2). The development of knowledge on the operationalisation of educational practices that enhance the students' experiential learning requires the inclusion of a bottom-up approach from experiential learning towards operationalisation with the use of empirical-inductive methods. Through Case Keramikk and Case Sveip, I have inquired into these domains, identified possibilities and challenges, constructed models for further studies in the field and developed the concept of a craft-based DfS as an approach to ESD in the school subject Art and Crafts.

6.2. DfS practices in theories and students' work

The first challenges I discovered when interviewing students were two diverging viewpoints on whether environmental concerns in product design are useful or disruptive to the learning of

craft-based designing. Some of the students found environmental considerations relevant, while other described it as a theoretical topic with key answers, and they worried that this topic would disrupt the school subject's purpose of engaging in creative processes and practical design and handcraft work, as well as shift the practice in classes from practical to theoretical work. These students do not stand alone with their concerns. Nielsen (2009) writes that theory and practice have been seen as dichotomies in the traditions of the school subject Art and Crafts but argues that theory in terms of reasoning and explanations should rather be considered complementary and used to strengthen practice (Nielsen, 2009, pp. 33, 80, 100–101).

Still, the ability of educational practice to encounter the students' perspectives on the purpose, relevance and work method in the school subject is essential to the students' learning process. By consulting Klafki's theory (see section 3.3.2), I found the possibility of starting with the students' craft-based designing and broadening their horizons through reasoning on examples of DfS principles and practices during and after they made their product. This theoretical reasoning and reflecting during and after the practical work drew only a modest amount of time from the educational practice in the two case studies (i.e. approximately 1.8% in Case Keramikk and 7.5% in Case Sveip). The relevance of employing DfS in the development of examples became evident in Case Keramikk, where the students' experienced learning corresponded with the reasoning in theories on DfS practices. In Case Sveip, the teachers found it relevant to include this reasoning during the students' decision-making about the design in sketches, work drawings and material selection, and in the assessment of their finished product. Afterwards, the majority of the students evaluated their acquired knowledge on environmental concerns as being useful for their design and crafts practice, education and future work (Maus, 2019b, pp. 97–98).

The DfS theories describe professional product design for manufacturing in a language suitable for university level. However, the theoretical reasoning and explanations of general ideas on DfS practice support the development of craft-based design practice in lower secondary education, and from my case studies of these spring new theoretical reasoning.

6.3. Design literacy for sustainability by craft-based DfS

In this section, I will address how the results from the case studies contribute to the field of research. To do so, I discuss the possibilities and challenges of the frameworks for students' engagement in the case studies and of two other frameworks for students' engagement

presented in associated works (Bråten & Kvalbein, 2014; Lutnæs, 2017). To structure the discussion, I employ the *Model of educational practice in DfS, variation 4* (Figure 7), which outlines the students' engagement with the influence between the student (the subject), his or her design product (present object) that is present in the school studio and the products' potential environmental impacts (absent object) that are absent from the school. On this variation of the model, I apply the different frameworks for students' engagement and derive three areas for discussion. These involve the students' engagement with:

1) *Design product* (present object) – *environmental impacts* (absent object), in reflection on DfS principles and practices in craft-based design through LCT (Maus, 2019a) and introductions and tightly structured tasks (Maus, 2019b).
2) *Student* (subject) – *design product* (present object), in an artefact analysis for transformation of the object through craft-based upcycling (Bråten & Kvalbein, 2014).
3) *Student* (subject) – *environmental impacts* (absent object), in reflective inquiry to rethink consumption culture (Lutnæs, 2017).

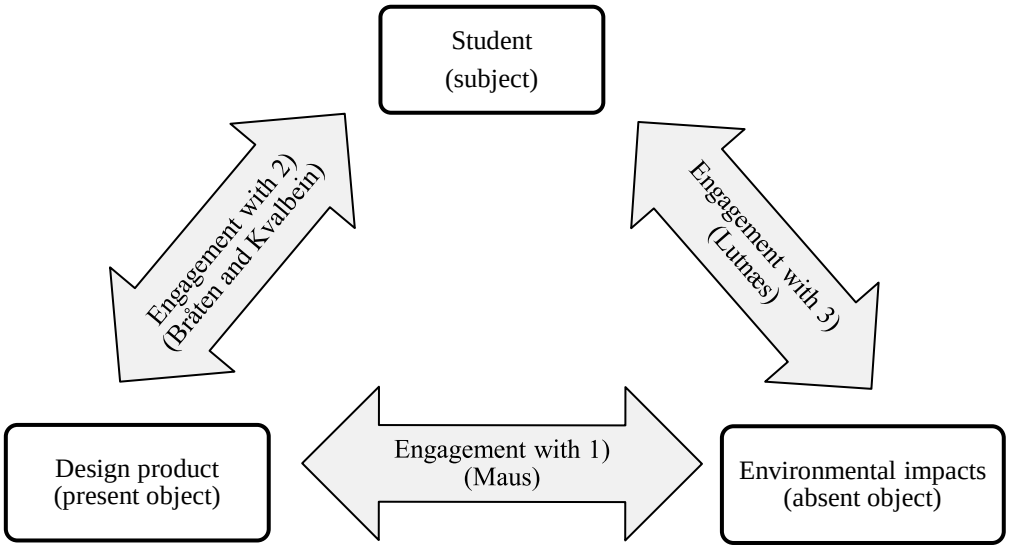


Figure 7: The Model of educational practice in DfS, variation 4 structures the discussion on frameworks for students' engagement in: 1) Design product – environmental impacts, 2) Student – design product, and 3) Student – environmental impacts.

The frameworks by Bråten and Kvalbein (2014) and Lutnæs (2017), are contemporary works, published within the timespan of this PhD project. In common with my framework (Maus, 2019a, 2019b), these also concern the students' engagement with reflection on design products. However, they were developed with different methods and with different intentions than the

aim of enhancing youths' design literacy for sustainability in my inquiry. The structuring of these three frameworks for students' engagement on the triangular model above reveal that they focus on different aspects of the influence between students, products and environmental impacts. Therefore, these should be considered complementary, rather than comparable. Together they form a foundation for future inquiries, which is essential for this young field of research. The applicability of a variation of the *Model of educational practice in DfS, variation 1* (Maus, 2017, p. 164) in this discussion on the contributions of my results to the field of research also shows the model's analytical generalisability, thus its validity (see section 4.5).

6.3.1. Engagement in the design product–environmental impact

The students' (subject) engagement with the influence between their design products (present object) and their environmental impacts (absent object) are the focus in the inquiries in Case Keramikk (Maus, 2019a) and Case Sveip (Maus, 2019b). Because the products' environmental impacts could not be exemplified in the school studio, as these accumulate over time in other environments, two frameworks were developed and tried out. Both frameworks enhanced the students' reflections on examples of DfS practices in their product item and the situations of their production process. The exemplified DfS practices were designs for cradle-to-grave eco-efficiency, cradle-to-cradle eco-effectiveness and product durability, based on the DfS principles of LCT on the products' life cycle and TBL aims for sustainability with environmental quality, social equality and economic prosperity.

The framework for students' reflections developed and tried out in Case Keramikk were questions for students' LCT on craft-based design products they had made. Through collaborative reflections on prepared questions with open-ended answers, improvised elaborative and confirmative questions, the students revealed the possibilities of exemplifying DfS in their products to enhance their design literacy for sustainability. The results were that the students used experiential learning in their reflections, which corresponds to the DfS practices in the production phase of their product. Also, they used experiential learning on distinctive characteristics of materials, products and production that are decisive for DfS practices in the phases of material extraction and use and disposal (Maus, 2019a).

The framework for students' reflections developed and tried out in Case Sveip consisted of introductions and tightly structured tasks on examples of DfS principles and practices from the students' craft-based design products. These reflections were conducted both during and after the students made their products. Possibilities of enhancing the students' design literacy for

sustainability were found in this case study. Among the results were the students' experience of learning, mastering and valuing the relevance of DfS. However, a challenge also arose regarding the students' lack of experiential learning of design for product durability as a DfS practice. In the discussion in the article (Maus, 2019b), I draw on Chapmans' (2010, 2015) description of subject-object relationship in design for emotional durability, which I expand by referring to the concept of object-object relationship. By placing these in the *Model of educational practice in DfS, variation 3* (Maus, 2019b, p. 103), I visualise how design for product durability focuses on the relation between the design product (present object) and the student (subject), to reduce the risk of the student disposing of the product and causing indirect environmental impacts (absent object). The examples in this project did not sufficiently engage the students' (subject) attention regarding their influence on the environmental impacts (absent object), if they dispose of their product. This may explain why it was more challenging for the students to learn that design for product durability is a practice in DfS, than design for eco-efficiency and eco-effectiveness to reduce direct environmental impacts. For this area, the framework by Lutnæs (2017) suggests an approach that I will examine (see section 6.3.3). However, first I will discuss an approach to engage students in reflections on their products, which are different than the approaches developed in Case Keramikk and Case Sveip.

6.3.2. Engagement in the student–design product

The students' (subject) engagement with the crafting of their design product (present object) through material reuse is in focus with the work of Bråten and Kvalbein (2014). They define their reuse of materials from products as upcycling,[29] with emphasis on the symbolic and user values that reused materials add to the creative design process and products. Their descriptions and examples resemble craft-based upcycling (see section 2.4.); thus, I refer to their work as craft-based upcycling. Bråten and Kvalbein neither present students' learning of environmental consideration as their motivation and aim, nor define their work within the context of ESD. They write that material reuse can be motivated by scarcity, morality (e.g. sustainable development), method, trend, memories and personal belongings[30] (Bråten & Kvalbein, 2014,

[29] In Norwegian oppvinning.
[30] In Norwegian mangel, moral (f.eks. bærekraftig utvikling), metode, mote, minner, mitt eget.

pp. 80–141). However, the possibilities embedded in their framework for reflections and circular use of materials should not be ignored.

The framework developed by Bråten and Kvalbein (2014) is an artefact analysis[31] for the transformation of the object in craft-based upcycling. The framework comprise a craft-based upcycling process with the focus on being a creative individual in the encounter with the artefact, wherein the individual develop an understanding of the artefact before transforming the object.[32] To develop an understanding of the artefact, they introduce a framework for artefact analysis with 1) description, 2) interpretation and 3) association of the objects'; a) form, b) function, c) intension, d) material and e) time [33]. In a table, they present examples of questions for use in analysis, but the extensive table is not intended for direct use by young students (Bråten & Kvalbein, 2014, pp. 142–191).

The possibilities for students' development of design literacy for sustainability through this artefact analysis *before* craft-based upcycling would be interesting to investigate, as students' reflections and their design process would be in reverse order of the *Model of LCT in craft-based design* with reflections based on experiential learning *after* the craft-based designing (section 5.2). The artefact analysis focuses on the form, function, intension and material of objects, which are associated with the product qualities used in students' LCT on their products in Case Keramikk. The artefact analysis of the time aspects of the object can open this LCT and broaden the students' horizons on their product (present object) in the school studio to include its environmental impacts (absent object). It is in the space between these two that the environmental benefit of reusing object materials in new products can be understood.

Bråten and Kvalbein (2014) point out the challenge of keeping a balance between *aesthetic goals* within the educational activity and *instrumental goals* beyond the educational activity in the upcycling activity in education. They acknowledge the value of an increased focus on environmental challenges but warn that if this focus is not combined with crafting, creative development and creative work, the design activity can become professionally poor (Bråten &

[31] In Norwegian tinganalyse.
[32] In Norwegian å være et skapende individ i møte med tingen, å forstå tingen, å transformere objektet.
[33] In Norwegian 1) beskrivelse, 2) tolkning og 3) assosiasjon av objektets; a) form, b) funksjon, c) intensjon, e) materiale, d) tid.

Kvalbein, 2014, pp. 198–199). Similar concerns were also brought up by the students in Case Keramikk, which led to my development of the *Model of educational practice in DfS, variation 1* (section 5.1). Today, learning about environmental considerations in design cannot be defined as an instrumental goal of design education. Still, I acknowledged these concerns. Therefore, I used timekeeping in Case Sveip to inquire into the matter, with the result that inclusion of the environmental context drew a limited amount of time for the aesthetic experience in the craft-based design process (Maus, 2019b, pp. 97–98). Thus, these concerns should not be a hindrance to embed questions on products' environmental impacts in the artefact analysis for craft-based upcycling.

6.3.3. Engagement in the student–environmental impact

The students' (subject) engagement with the environmental impacts (absent object) resulting from their consumption is the focus of the work by Lutnæs (2017), which she defines within the context of Education for Sustainable Consumption (ESC).

The framework developed by Lutnæs (2017) structure a reflective inquiry for students to rethink consumption culture, with the aim of enhancing the skills to rethink and transform patterns of unsustainable practices in the consumption of products. Such an approach is intended to open reflections without the exemplification of solutions in the designing process. The framework is based on key texts on reflective inquiry and systems-oriented design, for the purpose of enhancing the skills to rethink and transform patterns of unsustainable practices in the consumption of products. The four steps in the framework consist of the following: 1) confrontation, 2) exploration, 3) evaluation and 4) transformation. The exploration phase uses GIGA-mapping to make a collage of the consumption habits and stakeholders throughout the life cycle of the product (Lutnæs, 2017).

The possibilities in this framework contribute to engagement with the influence between the student and the environmental impact, for which Case Sveip lacked enough examples (Maus, 2019b). Also, the framework contributes to the enhancement of students' skills for developing practical problem-solving solutions, as opposed to the frameworks for students' engagement with established DfS principles and practices in craft-based LCT (Maus, 2019a), as well as introductions and tightly structured tasks (Maus, 2019b). Thereby, the reflective inquiry to rethink consumption culture can contribute by bridging towards discussions on the purpose and function of *what to design*, as discussed in DfS-theories by Papanek (1985), Stegall (2006) and Clune (2010), rather than on *how to design* products in craft-based DfS in Case Keramikk and

Case Sveip. However, the students' mapping of environmental impacts from their consumption could benefit from exemplification in products that are physically present in the school studio. As Case Keramikk reveals, the student's experiential learning on product qualities is useful for their reflection on products' environmental impacts (Maus, 2019a). Also, one potential challenge to the reflective inquiry to rethink consumption culture is students' concerns that environmental impacts will draw the focus away from the practical craft-based design work (Maus, 2017). A possible solution could therefore be to use the four-step inquiry as an initial study in a craft-based design process. Lutnæs' (2017) framework complement to the area where the frameworks by Bråten and Kvalbein (2014) and Maus (2017, 2019a, 2019b) lack approaches, and together these frameworks support each other in enhancement of design literacy for sustainability among youth.

6.3.4. The DfS and LCT models enhance design literacy

The models of educational practice in DfS and LCT in craft-based design and their embedded DfS principles of LCT and TBL and DfS practices for eco-efficiency, eco-effectiveness and product durability (see section 3.2, Table 1) represent structured knowledge with the potential for enhancing design literacy for sustainability. Successively, these have been developed and employed as frameworks throughout the work with the case studies, the articles and the discussion of this synopsis. Within the theory of knowledge, structured knowledge is described as models that reduce both the complexity and the oversimplicity of how boundaries, distinctions, connections and combinations of related issues presuppose each other (Jensen 2012, p. 175). These tools give an overview, which help to combine and use resources of different origins in the future and to organise it in different contexts (Klette & Carlsten, 2012, pp. 80–81; see section 3.3.4.). In design education, structured knowledge on DfS principles and practices informs and supports, with technical rationality, reflections on problem solving in the design process when consequences of choices cannot be experienced in the situation, incident or item. My structuring of this knowledge, which was based on a model by Cooper (2005; see section 3.2.3.), proved useful in the development of the interview questions, introductions, tasks and thematic analysis (see section 4.3 and 4.4.). In the case studies, this structured knowledge corresponded with the experiential learning the students used in LCT and it enhanced the students' experiential learning of DfS in craft-based design (see section 5.2. and 5.3.). Thus, this structured knowledge of DfS principles and practices has potential as a framework in further craft-based design projects with students. The models of educational practice in DfS and

LCT in craft-based design structure knowledge concerning the educational practice and are useful as frameworks to support learning, teaching and research among the students and teachers in Specialised Teacher Training in Design, Art and Crafts and among teachers in the school subject Art and Crafts. The models of LCT in craft-based design focus on students' reflections on their products, while the models of educational practice in DfS provide a broader perspective on educational practice, which also functions in this section as a framework for structuring the relation between the results from this research project and associated work in the field.

6.3.5. The DfS and LCT models contribute to ESD in craft-based design

One aim of this research project on the enhancement of students' design literacy for sustainability is to develop the knowledge needed to advance youths' education in craft-based design within the context of ESD. The models of educational practice in DfS and LCT in craft-based design, which I developed in this project, contribute relevant knowledge. It was my starting position and remains my stand that ESD is not a separate concept apart from the school subjects, but an initiative for the development of all school subjects. UNESCO writes about ESD that 'It is interdisciplinary and transdisciplinary, meaning that no discipline can claim ESD as its own, but all disciplines can respond and contribute to ESD individually and/or collectively' (UNESCO, 2018, p. 35). This project contributes individually from and within the discipline of the school subject Art and Crafts in Norwegian lower secondary education, where I have reviewed the associated research and developed case studies on craft-based design with students' reflections on principles and practices employed from professional DfS (see chapter 2 and section 4.3. and 4.4.). Moreover, I have published the results in journals on design education; *FormAkademisk – Research Journal for Design and Design Education* (Maus, 2019a) and *Techne Series – Research in Sloyd Education and Craft Science A* (Maus, 2019b). A different approach that contributes to the development of the field of environmental learning can be found in an associated PhD project in Sweden, in which Hofverberg (2019) reviewed the research on environmental education and found only a few projects concerning crafts. Thereafter, she conducted case studies on students' engagement with their product in craft processes that can be associated with environmental considerations and published the results of these in journals on environmental education.

The inter- and transdisciplinary nature of ESD leads to the cross-curricular use of knowledge in school projects on craft-based DfS. In Case Keramikk and Case Sveip, this includes

knowledge on the TBL aims of environmental quality, social equality and economic prosperity. Others suggest the use of ecological literacy (Lutnæs & Fallingen, 2017). This knowledge is used in the design process for improving the products' design. Therefore, the learning of this knowledge cannot be considered as merely serving the instrumental goals of supporting other school subjects. Design education must emphasise designing for the real world (Papanek, 1985), and the real world of today and of the students' future, comprise a world of environmental challenges caused by the production, use and disposal of products. In this world, environmental considerations constitute a quality criterion for product design and core knowledge in design education. Thereby, learning of environmental considerations serves not only ESD, it serves and revives craft-based design education itself.

6.4. Sustainable development through design literacy

The possibilities for students' development of design literacy for sustainability through the methods employed, leads to questions whether the design literacy acquired by youth can support the aim of their participation in democratically sustainable development, as argued in associated research (Digranes & Fauske, 2010; Nielsen & Brænne, 2013; Nielsen & Digranes, 2007, 2012). Aspects to consider are how youths' design literacy support the implementation and development of DfS principles and practices. Moreover, how such an approach supports youths' democratic participation in the development of sustainable societies.

6.4.1. Implementation of DfS principles and practices

As citizens, the youth are stakeholders in the implementation of DfS practices. Their practices of choosing, buying, using, modifying, making, maintaining, repairing and disposing products put them in an everyday position as stakeholders in the implementation of environmentally considerate practices throughout products' life cycle. The youths' ability to do so depends upon their design literacy. Thus, their development of knowledge, skills and values regarding the principles and practices for sustainable development are the aims of ESD (UNESCO, 2005a, 2014a). Today, sustainability is being pushed into the curricula by design educators and pulled into the practice from regulations, while the design professions are behind on sustainability (Giard & Schneiderman, 2013, p. 124). The consumers' competence is therefore of substantial significance. Heiskanen (2002) accentuates the utility of buyers and suppliers sharing the concept of LCT. In these case studies, I followed the advice of Goodlad et al. (1979, pp. 64–65) of employing similar concepts across the educational system, by using the principles of

LCT and TBL and related DfS practices from professional education in general education. According to the students' self-evaluation in Case Sveip, they experienced their acquired learning as understandable and relevant, although most responded that it was useful for their own design and crafts work in general and in their present and future education (Maus, 2019b, pp. 98–99). Additional engagement with examples of DfS in manufactured products could be relevant here.

6.4.2. Development of DfS principles and practices

Equally important to the youths' participation in the implementation of DfS principles and practices, is their participation in the further development of these. One could imagine that an educational focus on today's DfS principles and practices, as in Case Keramikk and Case Sveip, could enhance stagnation rather than development. However, knowledge is not a hindrance to creative work (Nielsen, 2009, pp. 100–101, 110–111). From an historical perspective, we see that in most cases design is developed based on existing ideas (Michl, 2002). DfS practices are no exception. The possibilities for individual interpretations and development are present in, for example, design for product durability through outer aesthetic and intrinsic product qualities (Cooper, 2005, 2010), functional product qualities (Stahel, 2010) and emotional durability (Chapman, 2009, 2010, 2015).

The knowledge each student acquires on DfS will be similar, but neither equal nor static. On the contrary, their knowledge is individual and undergoes continuous development in encounters with design products and processes. Klafki (1959/2001, 1985/2001) explains how holistic knowledge develops within each individual, through engagement with examples where their subjective conditions for critical thinking, judgement, will and imagination encounters the objective knowledge on the general ideas from the field. Thus, each student will develop their understandings on DfS. Sharing their understandings with fellow students and teachers will provide richness to the field and enhance the ongoing interpretation and renewal of the DfS principles and practices and their significant meaning. Therefore, learning to use DfS principles in practice cannot result in stagnation of the development towards sustainability, even though these are defined means towards defined ends.

Schön (1991) argued that reflections based on defined means towards defined ends are a technical rationale that supports defined solutions to defined problems, rather than seeking or solving unique or unstable problems and conflicts of interests. DfS most certainly is an area with unstable problems and conflicts of interest, but also an area where several problems and

possible solutions have been defined and are awaiting refinement and implementation on a larger scale. Because the products' environmental impacts cannot be observed during production, DfS requires the use of a technical rationale. As long as DfS is employed in the students' own craft-based design practice, the use of a technical rationale will always be combined with reflection in and on the action in the continuous numbers of unstable problems and conflicts of interests to solve.

6.4.3. Design literacy for democratically sustainable development

The indications of engagement with DfS principles and practices as a fruitful approach to the enhancement of design literacy raises another question concerning the overall aim of ESD in design education for youth. This concerns whether the youths' acquired design literacy supports their democratic participation in the development of sustainable societies. Klafki (1985/2001) emphasised work with examples and educational topics that enhance autonomy in terms of self-determination, co-determination and solidarity. The results from the case studies and discussions based on Klafki's ideas are optimistic, but is the emphasis on exemplification and relevant topics enough? In this regard, I will bring one more perspective to this discussion.

Biesta (2006) describes the focus on the development of individuals' knowledge and skills as individualistic and instrumental approaches in education for democratic participation and warns that we cannot know how people choose to use their knowledge. Therefore, education must create opportunities for individuals to be active and experience participation in a world of plurality, in a way that their action does not obstruct opportunities for others (Biesta, 2006, pp. 117–145). In Case Sveip, educational practices were developed to create opportunities for each individual student to experience participation in craft-based design practice with reflections on product design to support environmental sustainability and thereby avoid obstructing the opportunities of others. According to the students' self-evaluation, they experienced the topic as understandable and relevant for their future design and crafts practice in general or in their present and future education and professional life. They experienced learning and trust that they will have opportunities to use their acquired knowledge in future school projects. Thus, indications are that DfS should be embedded throughout craft-based design practice in school, rather than being treated as a niche topic embedded in some of the projects.

6.5. Methodological considerations

The research design with a mixed method approach (see section 4.2.) presents immanent ontological and epistemological challenges as regards the researcher's role, the results and their use across the cases, which I acknowledge. However, overall the research design proved fruitful and was in line with Johnson and Onwuegbuzie's (2004) description of mixed methods as making use of the pragmatic method and system of philosophy, recognising both quantitative and qualitative research as being important and useful.

The usefulness of the mixed method is evident in the results. In Article 1, I presented qualitative, empirical data on the students' worries that environmental considerations as an educational topic would disrupt the educational practice in craft-based design. This I followed up through quantitative methods of timekeeping on the interviews in Article 2 and the works with DfS introductions and tasks in Article 3, disclosing that the reflections on DfS draw minimal time from the craft-based design. In addition, I used their worries as a stepping stone for the theoretical-deductive approach, which leads to the *Model of educational practice in DfS*, which I further used in discussions on the results in Articles 2 and 3.

Methodological considerations are also about choices and shifts of theoretical perspectives. During this project, I have made three shifts of importance. Before making the *Model of educational practice in DfS*, I attempted to analyse the students' expressions in light of the analysis that Klafki presents as the background for his development of the kategorialen Bildung theory (Klafki, 1959/2001, pp. 171–185). If not totally incorrect, the result was at least unreasonable towards the students, as it illuminated challenges rather than possibilities and was therefore useless for development of the educational practice in the field. Thus, the draft was shelved. Another draft that was shelved along the way was an analysis of the DfS theory in light of the model of didactic relations (Bjørndal & Lieberg, 1978, pp. 135–138; Hiim, 2016, pp. 152–154), because I experienced the model as more useful for mapping than for a deeper inquiry. I also restructured the DfS theoretical framework for data construction and analysis, from use of the philosophy for ecologically intentional design (Stegall, 2006) to use of the model on eco-efficiency, slow consumption and product life spans (Cooper, 2005). These theories comprise the same topics, but an expanded version of Cooper's (2005) framework corresponded better with the data.

In the data construction, I experienced challenges as a beginner. First, by constructing too much data, which stretched in different directions. In addition to the data used in this thesis, I constructed data from my own teaching practice in teacher training for students with subject specialisation in Art and Crafts, concerning those adult students' interpretations of the operationalisation of DfS in education for youth. These data had a different character that made them difficult to fit in, so I asked for advice from an experienced researcher at NAFOL and then laid these data aside. Second, in the semi-structured interviews, my experience as a teacher rather than an interviewer became clear to me, as I had to hold back on enhancing the students' development of understanding, to get the data I wanted. The interview guide and planned interview method significantly contributed to the quality of these interview data. Third, the challenge, but also the importance, of employing and updating LCA data on materials in Case Sveip became obvious as the data on the status of ash that was used in the woodwork became outdated during the project (Maus, 2019b, p. 100).

6.6. Conclusion and implications

The possession of design literacy to understand and create design that supports sustainable environments enables youth to participate in sustainable development and should therefore be emphasised in craft-based design education for youth. So far, associated research in Norwegian education has focused on the perceived interpretations among researchers (see chapter 2). In this research project, I address the operationalised educational practice and the students' experiential learning and employ two case studies to inquire into the possibilities and challenges involved in craft-based design education to enhance youths' design literacy for sustainability.

The first challenge I located was two diverging viewpoints among the students on whether environmental considerations are a relevant or a disruptive topic in their craft-based design education. To inquire into this challenge of how to make this educational topic relevant for all the students, I developed the *Model of educational practice in DfS*. In this model, I identified the possibility of starting in the students' design product and engaging the students in reflections on examples of DfS practices to broaden their horizons regarding the products' potential environmental impacts (Maus, 2017).

This possibility was further investigated through two different frameworks in the case studies. First, through the students' LCT on their craft-based design products in Case Keramikk, where I noted the possibilities of students using experiential learning from craft-based designing in

the assessment of their product and making estimates about environmental considerations. The students used experiential learning that corresponds with DfS practices for eco-efficiency, eco-effectiveness and product durability in the production phase, along with the distinctive characteristics of materials, products and production decisive for the practice of these in the phases of material extraction and use and disposal. In this inquiry, I developed the *Model of LCT in craft-based design* (Maus, 2019a). Thereafter, I proceeded through introductions and students work with tightly structured tasks on examples of DfS principles and practices during and after they had designed and crafted their products in Case Sveip. I next determined the possibilities for embedding DfS without expending a disruptive amount of time, as well as acknowledging the students' experiential learning of DfS to be understandable, manageable and useful in their design and crafts practice in general or in their education and future work (Maus, 2019b). In both case studies, the exemplification of the students' own product enhanced the experience of relevance, while the questions, introductions and tightly structured tasks were crucial to opening the students' engagement with the environmental context of their product. I will return to the implications of these possibilities for the development of the craft-based design education (see section 6.6.1).

Two more challenges also arose. In both cases, the students' craft-based design products provided examples for reflection on the working conditions in production and environmental considerations in products, but not manufactured consumer products or unsustainable consumption. As regards the aim of developing the students' design literacy for participation in sustainable development of production and consumption, this is a challenge. Another challenge, located in the students' self-evaluation responses in Case Sveip, arose from indications that the students were further along in their development of design literacy in DfS practices for eco-efficiency and eco-effectiveness than for product durability. I could find no explanation for this imbalanced result in the introductions and tasks on the topics, the timekeeping of the students' work with these topics or the students' expressed understanding while working with the project. Therefore, in the article, I discuss whether such an imbalance can be attributed to the distinct characteristics of these DfS practices (Maus, 2019b). I will return to the implications of these challenges in the recommendations for further research.

6.6.1. Implications for the development of education in craft-based DfS

The implications from these empirical case studies need further research and development of sustainability as an educational topic in craft-based design education for youth. The study builds

on the recommendations for empirical studies (Nielsen & Digranes, 2012) from related research (Digranes & Fauske, 2010; Nielsen & Brænne, 2013; Nielsen & Digranes, 2007, 2012) and a reading of the body of research in this study in relation to ongoing international initiatives for the development of ESD (UNESCO, 1997, 2005a, 2012, 2014a, 2014b, 2016, 2018). From this study, I suggest three main implications for the further development of ESD in design education for youth. These consist of the following: Acknowledgement of: 1) education in craft-based DfS as ESD; 2) the students' craft-based design as DfS examples; and 3) DfS practices for eco-efficiency, eco-effectiveness and durability in ESD for youth.

Acknowledgement of education in craft-based DfS as ESD. These studies of Case Keramikk and Case Sveip illuminate how craft-based DfS in the school subject Art and Crafts can contribute to and be included under the umbrella of ESD. Practical craft-based DfS in the school studio includes examples, knowledge, skills and values on the principles and practices in solutions to today's sustainability challenges. These are all aspects of the intention of ESD (UNESCO, 2005a, 2014a), but the contributions of this school subject have been omitted from Norway's strategy on ESD (Melkild, 2016). One implication of the results in this research project is that further Norwegian ESD initiatives must broaden their horizons to encompass youths' participation in, and democratic development of, education in craft-based DfS. Sustainability is implemented as an educational topic on the core curriculum and the curriculum for the school subject Art and Crafts, thus other national initiatives should follow.

Acknowledgement of the students' craft-based design as DfS examples. Engagement with examples that visualise the general idea of the topic in the situation, incident or item as relevant for the student, enhance the development of holistic knowledge (Klafki, 1959/2001, 1985/2001). These case studies imply that the field of research and development of design education for youth must acknowledge the students' own designing and crafting processes and products as examples for engagement with and reflection upon environmental considerations in design. These examples visualise DfS practices for the students in their products' production phase and the distinctive characteristics of materials, products and production decisive for the practice of these in the material extraction and use and disposal phases. Thus, the relevance of design literacy for sustainability for their own present and future design and crafts practice is also confirmed.

Acknowledgement of DfS practices for eco-efficiency, eco-effectiveness and product durability in ESD for youth. According to UNESCO, the aim of ESD is to provide '. . . learners across the

world with the knowledge, skills and values to discover solutions to today's sustainability challenges' (UNESCO, 2014a, p. 3). This might lead to the misconception that most solutions are yet to be discovered. However, DfS practices for eco-efficiency with low use of resources cradle to grave (Cooper, 2005, 2010), eco-effectiveness with circular use of resources cradle to cradle (McDonough & Braungart, 2009, 2013) and product durability and longevity (Chapman, 2009, 2010, 2015; Cooper, 2005, 2010; Stahel, 2010) are all solutions to sustainability challenges. A result of this research is that these are all exemplified and available for reflections in the students' products. Among the implications for research into and development of ESD in craft-based DfS is the acknowledgement that while some solutions for eco-efficiency and eco-effectiveness and product durability remain to be discovered, others are to be re-discovered in the traditions of the craft-based design and implemented on a larger scale.

6.6.2. Recommendations for further research

This research project on the operationalised education and students' experiential learning in craft-based DfS contained possibilities for exemplifying DfS practices in the students' craft-based design products among the results. But challenges that call for further research in the operationalised and experiential domains of education in craft-based DfS were also disclosed. In both cases, the students' craft-based designing provided strong examples for reflection on working condition in production and environmental considerations in products, but weak examples for reflection on sustainable or unsustainable consumption. Further research in craft-based design for a strengthening of the students' experiential learning on sustainable use and consumption is required, to support the intentions of ESD. Development of design literacy for sustainable consumption is a premise for sustainable development in a world where the production of products consumed in households leads to major negative environmental impacts (Ivanova et al., 2015).

Another challenge for further research is located in Case Sveip, where the students were shown to be further along in their development of design literacy in DfS practices for eco-efficiency and eco-effectiveness than for product durability. The reasons for this result were not found in the documentation of the educational practice, thus I question whether this can be attributed to the distinct characteristics of these DfS practices (Maus, 2019b). Further research can indicate whether this result is specific to Case Sveip or part of a general trend. Also, the question arises whether eco-efficiency, eco-effectiveness and product durability are promoted differently in formal, non-formal and informal education (UNESCO, 2014a, pp. 20, 30–31) and thereby

enhance students' preconceptions differently. In addition, inquiries need to be made whether more approaches to enhance students' experiential learning on product durability are needed. The development of craft-based design education that enhances students' design literacy for democratic participation in sustainable production and consumption of products requires research-based knowledge on these issues.

7. References

Alvesson, M. & Sandberg, J. (2018). Metaphorizing the Research Process. In C. Cassell, A. L. Cunliffe, & G. Grandy (Eds.), *The Sage Handbook of Qualitative Business and Management Research Methods; Vol. 2: Methods and Challenges* (pp. 486-505). London, UK: Sage.

Alvesson, M., & Sköldberg, K. (2009). *Reflexive methodology: New vistas for qualitative research* (2nd ed.). London, UK: Sage.

Aristoteles. (1996). *Etikk: et hovedverk i Aristoteles' filosofi, også kalt "Den nikomakiske etikk"* [The Nicomachean Ethics] (A. Stigen, Trans.) (2nd ed.). Oslo, Norway: Gyldendal.

Bangsund, M. (2017). *Relasjoner mellom menneske og ting – Materialitet og forbruk i et designdidaktisk perspektiv* [Relations between humans and objects – Materiality and consumption in a design educational perspective] (Master's thesis, Oslo and Akershus University College of Applied Sciences [HiOA], Norway). Retrieved from https://hdl.handle.net/10642/6005

Bhamra, T. & Lofthouse, V. (2007). *Design for sustainability: A practical approach*. Aldershot, UK: Gower.

Bhaskar, R. (1998). *The possibility of naturalism: A philosophical critique of the contemporary human sciences* (3rd ed.). Abingdon, UK: Routledge.

Bhaskar, R. (2008). *A realist theory of science*. Abingdon, UK: Routledge.

Biesta, G. J. J. (2006). *Beyond learning: Democratic education for a human future*. Boulder, CO: Paradigm.

Bjønnæs, S. R. (2014). *Bak den grønne døren: Bærekraft – I dialog med elever* [Behind the green door: Sustainability ─ In dialog with students] (Master's thesis, Oslo and Akershus University College of Applied Sciences [HiOA], Oslo, Norway). Retrieved from http://hdl.handle.net/10642/2094

Bjørndal, B. & Lieberg, S. (1978). *Nye veier i didaktikken?: En innføring i didaktiske emner og begreper* [New paths in education?: An introduction in educational topics and concepts]. Oslo, Norway: Aschehoug.

Boehnert, J. (2013). Ecological literacy in design education: A foundation for sustainable design. In J. B. Reitan, P. Lloyd, E. Bohemia, L. M. Nielsen, I. Digranes, & E. Lutnæs. *Design education from kindergarten to PhD – Design learning for tomorrow: Proceedings of the 2nd international conference for design education researchers* (Vol. 1, pp. 442–457). Oslo, Norway: ABM-media.

Boehnert, J. (2015). Ecological literacy in design education: A theoretical introduction. *FormAkademisk - Research Journal of Design and Design Education, 8*(1), 1–11. https://doi.org/10.7577/formakademisk.1405

Brænne, K. (2009). *Mellom ord og handling: Om verdsetjing i kunst og handverksfaget* [Between words and actions: About valuation in the school subject Art and Crafts]. (Doctoral dissertation, The Oslo School of Architecture and Design [AHO], Norway). Retrieved from https://aho.brage.unit.no/aho-xmlui/handle/11250/2406784?locale-attribute=en

Bråten, I. & Kvalbein, Å. (2014). *Ting på nytt: En gjenbruksdidaktikk* [Artefacts again: Reuse in education]. Bergen, Norway: Fagbokforlaget.

Brinkmann, S. & Kvale, S. (2015). *Interviews: Learning the craft of qualitative research interviewing* (3rd ed.). Thousand Oaks, CA: Sage.

Carson, R. (1962). *Silent spring*. Greenwich, CT: Fawcett.

Ceschin, F., & Gaziulusoy, I. (2016). Design for sustainability: An evolutionary review. In P. Lloyd & E. Bohemia (Eds.), *Proceedings of DRS2016: Design + research + society - future-focused thinking* (Vol. 10, pp. 3731–3754). doi: 10.21606/drs.2016.59

Chapman, J. (2009). Design for (emotional) durability. *Design Issues*, *25*(4), 29–35. https://www.mitpressjournals.org/doi/pdf/10.1162/desi.2009.25.4.29

Chapman, J. (2010). Subject/object relationships and emotionally durable design. In T. Cooper (Ed.), *Longer lasting products: Alternatives to the throwaway society* (pp. 61–76). Farnham, UK: Gower.

Chapman, J. (2015). *Emotionally durable design: Objects, experiences and empathy* (2nd ed.). Abingdon, UK: Routledge.

Christensen, K. S., Hjorth, M., Iversen, O. S., & Blikstein, P. (2016). Towards a formal assessment of design literacy: Analyzing K–12 students' stance towards inquiry. *Design Studies, 46*, 125–151. http://dx.doi.org/10.1016/j.destud.2016.05.002

Christensen, K. S., Hjorth, M., Iversen, O. S. & Smith, R. C. (2018). Understanding design literacy in middle-school education: Assessing students' stances towards inquiry. *International Journal of Technology and Design Education, 28*, 1–22. doi:10.1007/s10798-018-9459-y

Clune, S. (2007). Sustainability literacy for industrial designers through action research. In E. Bohemia, K. Hilton, C. McMahon, & A. Clarcke (Eds.), *DS 43: Proceedings of E&PDE 2007, the 9th international conference on engineering and product design education, University of Northumbria, Newcastle, UK, 13.–14.09.2007* (pp. 227-232). Glasgow, UK: Design Society. Retrieved from https://www.designsociety.org/publication/28400/Sustainability+literacy+for+industrial+designers+through+action+research

Clune, S. (2010). Deep Learning and Industrial Design Education for Sustainability. In G. Forsyth (Ed.), *Proceedings of ConnectED, Sydney, Australia, 28th June - 1st July, 2010* (pp. 1-5) University of New South Wales, Syndey, Australia

Cooper, T. (1997). Consumers, costs and choice. In E. van Hinte (Ed.), *Eternally yours: Visions on product endurance* (pp. 59–69). Rotterdam, The Netherlands: 010 Publishers.

Cooper, T. (2005). Slower consumption: Reflections on product life spans and the 'throwaway society'. *Journal of Industrial Ecology, 9*(1–2), 51–67. https://onlinelibrary.wiley.com/doi/epdf/10.1162/1088198054084671

Cooper, T. (2010). The significance of product longevity. In T. Cooper (Ed.), *Longer lasting products: Alternatives to the throwaway society* (pp. 3–36). Farnham, UK: Gower.

Dewey, J. & Dewey, E. (1915). *Schools of tomorrow*. New York: E. P. Dutton & Company. https://archive.org/details/schoolsoftomorro005826mbp/page/n9

Digranes, I. & Fauske, L. B. (2010). The reflective citizen: General design education for a sustainable future. In W. Boks, W. Ion, C. McMahon, & B. Parkinson (Eds.), *DS 62: Proceedings of E&PDE 2010, the 12th international conference on engineering and*

product design education – When design education and design research meet, Trondheim, Norway, 02.–03.09.2010 (pp. 364–370). Glasgow, UK: Design Society. Retrieved from https://www.designsociety.org/publication/30179/The+Reflective+Citizen+–+General+Design+Education+for+a+Sustainable+Future

Education Act. (1998). *Act relating to primary and secondary education and training* (ACT-17 July 1998 no. 61). Retrieved from https://www.regjeringen.no/contentassets/b3b9e92cce6742c39581b661a019e504/education-act-norway-with-amendments-entered-2014-2.pdf

Edwards, A. (2015). Designing tasks which engage learners with knowledge. In I. Thompson (Ed.), *Designing tasks in secondary education: Enhancing subject understanding and student engagement* (pp. 13–27). Abingdon, UK: Routledge.

Elkington, J. (1999). *Cannibals with forks: The triple bottom line of 21st century business*. Oxford, UK: Capstone Publishing.

Elliott, J. (2007). *Reflecting where the action is: The selected works of John Elliott*. Abingdon, UK: Routledge.

European Design Leadership Board. (2012). *Design for growth & prosperity*. Retrieved from: http://europeandesigninnovation.eu/wp-content/uploads/2012/09/Design_for_Growth_and_Prosperity_.pdf

Fallingen, N. (2014). *Business as usual? – Hvordan kultivere økoliteracy i grunnskolefaget Kunst og håndverk og valgfaget Design og redesign?* [Business as usual? – How to cultivate eco-literacy in the school subject Art and Crafts and the optional school subject Design and Redesign?] (Master's thesis, Oslo and Akershus University College of Applied Sciences [HiOA], Norway). Retrieved from http://hdl.handle.net/10642/2091

Fontana, A. & Frey, J. H. (2008). The interview: From neutral stance to political involvement. In N. K. Denzin & Y. S. Lincoln (Eds.), *Collecting and interpreting qualitative materials* (3rd ed., pp. 115–159). London: Sage.

Faud-Luke, A. (2009). *Design activism: Beautiful strategies for a sustainable world*. Abingdon, UK: Earthscan, Routledge.

Giard, J. & Schneiderman, D. (2013). Integrating sustainability in design education. In S. Walker & J. Giard (Eds.), *The handbook of design for sustainability* (pp. 121–136). London, UK: Bloomsbury.

Goodlad, J. I., Klein, M. F., & Tye, K. A. (1979). The domains of curriculum and their study. In J. I. Goodlad (Ed.), *Curriculum inquiry: The study of curriculum practice* (pp. 43–76). New York, NY: McGraw-Hill Book Company.

Green, M. (2014). Transformational design literacies: Children as active place-makers. *Children's Geographies, 12*(2), 189–204. http://dx.doi.org/10.1080/14733285.2013.812305

Gunnerød, S. (2014). *Søppelets ambivalens i samtidskunsten: Kan kunst påvirke vårt syn på samfunnets avfallsprodukter?* [The ambivalence of trash in contemporary art. Can art influence our view of society's waste products?] (Doctoral dissertation). University of Bergen, Norway.

Gustavsson, B. (2000): *Kunskapsfilosofi. Tre kunskapsformer i historisk belysning* [Philosophy of knowledge. Three forms of knowledge in an historical light]. Stockholm, Sweden: Wahlström & Widstrand

Gustavsson, B. (2012). Bildning och nytta [Formation and utility]. In Ø. Varkøy (Ed.), *Om nytte og unytte* [About utility and inutility] (pp. 93-111). Oslo, Norway: Abstrakt.

Heiskanen, E. (2002). The institutional logic of life cycle thinking. *Journal of Cleaner Production, 10*(5), 427–437. https://doi.org/10.1016/S0959-6526(02)00014-8

Hiim, H. (2010) *Pedagogisk aksjonsforskning: Tilnærminger, eksempler og kunnskapsfilosofisk grunnlag* [Educational action research: Approaches, examples and epistemological foundation]. Oslo, Norway: Gyldendal Akademisk.

Hiim, H. (2016). Educational action research and development of professional teacher knowledge. In E. Gunnarsson, H. P. Hansen, B. S. Nielsen, & N. Sriskandarajah (Eds.), *Action research for democracy: New ideas and perspectives from Scandinavia* (pp. 147–161). Abingdon, UK: Routledge.

Hofverberg, H. (2019). *Crafting sustainable development. Studies of teaching and learning: craft in environmental and sustainability education* (Doctoral dissertation Uppsala

University, Sweden). Retrieved from http://uu.diva-portal.org/smash/get/diva2:1277258/FULLTEXT01.pdf

Hofverberg, H. & Kronlid, D. O. (2018). Human-material relationships in environmental and sustainability education – an empirical study of a school embroidery project. *Environmental Education Research, 24*(7), 955–968. https://doi.org/10.1080/13504622.2017.1358805

Hofverberg, H. & Maivorsdotter, N. (2018). Recycling, crafting and learning – an empirical analysis of how students learn with garments and textile refuse in a school remake project. *Environmental Education Research, 24*(6), 775–790. https://doi.org/10.1080/13504622.2017.1338672

Hohr, H. (2011). Kategorial danning og kritisk-konstruktiv didaktikk – den didaktiske tilnærmingen hos Wolfgang Klafki [Kategorialen Bildung and critical-constructive Didaktik – the Didaktik approach of Wolfgang Klafki]. In K. Steinsholt & S. Dobson (Eds.), *Dannelse: Introduksjon til et ullent pedagogisk landskap* [Formation: Introduction to an unclear pedagogical landscape] (pp. 163-175). Trondheim, Norway: Tapir Akademisk.

Idland, H. M. (2015). *Materialbruk i faget Kunst og håndverk: i forhold til et bærekraftig danningsperspektiv* [Material use in the school subject Art and Crafts: In relation to a sustainable perspective on formation] (Master's thesis, Oslo and Akershus University College of Applied Sciences [HiOA], Norway). Retrieved from http://hdl.handle.net/10642/2714

Illeris, H. (2012). Nordic contemporary art education and the environment: Constructing an epistemological platform for Art Education for Sustainable Development (AESD). *Nordic Journal of Art and Research, 1*(2), 77–93. https://doi.org/10.7577/information.v1i2.221

Ivanova, D., Stadler, K., Steen-Olsen, K., Wood, R., Vita, G., Tukker, A., & Hertwich, E. G. (2015). Environmental impact assessment of household consumption. *Journal of Industrial Ecology, 20*(3), 526–536. http://onlinelibrary.wiley.com/doi/10.1111/jiec.12371/epdf

Jensen, K. (2012): The desire to learn: An analysis of knowledge-seeking practices among professionals. In K. Jensen, L. Lahn and M. Nerland (Eds.): *Professional Learning in the Knowledge Society* (pp. 165–177). Rotterdam, The Netherlands: Sense.

Jenssen, Å. J. (2013). *Stukket av: En undersøkelse av hvordan kunstneriske strategier og arbeidsformer i prosjekter som jobber praktisk med kunst, natur og miljø kan åpne for arbeid med miljørelaterte spørsmål i skolen.* [Stung by: An examination of how artistic strategies and work methods in projects for practice in art, nature and environments can open for work with environmental questions in schools] (Master's thesis, Oslo and Akershus University College of Applied Sciences [HiOA], Oslo, Norway). Retrieved from http://hdl.handle.net/10642/1976

Johnson, R. B. & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(7), 14–26. https://doi.org/10.3102/0013189X033007014

Keitsch, M. (2012). Sustainable design: A brief appraisal of its main concepts. *Sustainable Development, 20*(3), 180–188. https://onlinelibrary.wiley.com/doi/full/10.1002/sd.1534

Kemmis, S. & Smith, T. (2008). Personal praxis: Learning through experience. In S. Kemmis & T. Smith. (Eds.), *Enabling Praxis. Challenges for education* (pp. 15-35). Rotterdam, The Netherlands: Sense.

King, N. & Horrocks, C. (2010). *Interviews in qualitative research*. London: Sage.

Klafki, W. (1959/2001). Kategorial dannelse: Bidrag til en dannelsesteoretisk fortolkning av moderne didaktikk [Kategorialen Bildung: A contribution to a Bildung theoretical interpretation of modern Didaktik] (A. Gylland, Trans.). In E. L. Dale (Ed.), *Om utdanning: Klassiske tekster* [About education: Classical texts] (pp. 167–203). Oslo, Norway: Gyldendal.

Klafki, W. (1985/2001). *Dannelsesteori og didaktikk – Nye studier* [*Bildung theory and Didaktik – New studies*] (B. Christensen, Trans.). Århus, Denmark: Klim.

Klette, K. & Carlsten, T.C. (2012): Knowledge in teacher learning: New professional challenges. I. K. Jensen, L. Lahn and M. Nerland (Eds.): *Professional Learning in the Knowledge Society* (pp. 69–84). Rotterdam, The Netherlands: Sense.

Kleve, B. & Penne, S. (2012). Cross-curricularity in a literacy perspective: Contrast, confrontation and metalinguistic awareness. *International Journal of Educational Research, 55,* 48–56. https://doi.org/10.1016/j.ijer.2012.06.004

Kunnskapsdepartementet [Ministry of Education and Research]. (2012). *Kunnskap for en felles framtid: Revidert strategi for utdanning for bærekraftig utvikling 2012–2015* [Knowledge for a common future: Revised strategy for education for sustainable development 2012–2015]. Retrieved from: https://www.regjeringen.no/globalassets/upload/kd/vedlegg/uh/rapporter_og_planer/strategi_for_ubu.pdf

Kvale, S. & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing* (2nd ed.). Thousand Oaks, CA: Sage.

Lefdal, E. M. (2005). Etisk designperspektiv [Ethical perspectives in design]. In L. M. Nielsen & Digranes I. (Eds.), *DesignDialog – Design og fagdidaktiske utfordringer (HiO-rapport 2005 nr 33)* [DesignDialog – Design and educational challenges (HiO-report 2005 nr 33)] (pp. 47–56). Oslo University College (HiO), Department of Art, Design and Drama, Norway. Retrieved from https://docs.wixstatic.com/ugd/9bb887_f5e46c8d5f9b4c28b252176297cba99c.pdf

Lutnæs, E. (2015a). Imagining the unknown – Responsible creativity for a better tomorrow. *FormAkademisk - Research Journal of Design and Design Education, 8*(1), 1–15. http://dx.doi.org/10.7577/formakademisk.1404

Lutnæs, E. (2015b). Kritisk refleksjon og systemorientert design – Bevisstgjøring og endringskompetanse gjennom Utdanning for bærekraftig forbruk. [Critical reflection and system-oriented design – Awareness and amending expertise through education for sustainable consumption]. *FormAkademisk - Research Journal of Design and Design Education, 8*(3), 1–16. http://dx.doi.org/10.7577/formakademisk.1433

Lutnæs, E. (2017). Rethinking consumption culture: Educating the reflective citizen. In A. Skjerven & J. B. Reitan (Eds.), *Design for a Sustainable Culture: Perspectives, Practices and Education* (pp. 171–184). Abingdon, UK: Routledge.

Lutnæs, E. (2018). Creativity in assessment rubrics. In E. Bohemia, A. Kovacevic, L. Buck, P. Childs, S. Green, A. Hall, & A. Dasan (Eds.), *DS 93: Proceedings of the 20th*

international conference on engineering and product design education (E&PDE 2018), Dyson School of Engineering, Imperial College, London. 6th–7th September 2018 (pp. 506–511). Glasgow, UK: Design Society. Retrieved from https://www.designsociety.org/publication/40842/CREATIVITY+IN+ASSESSMENT+RUBRICS

Lutnæs, E. (2019). Framing the concept design literacy for a general public. *Conference Proceedings of the Academy for Design Innovation Management*, *2*(1), 1294–1304. https://doi.org/10.33114/adim.2019.01.224

Lutnæs, E. & Fallingen, N. (2017). Bærekraftig utvikling gjennom skapende praksis: Utvikling av økoliteracy i et samlet kunst- og håndverksfag. [Art and craft education for sustainable development: Development of ecoliteracy in the school subject Art and Crafts]. *FormAkademisk - Research Journal of Design and Design Education*, *10*(3), 1–19. http://dx.doi.org/10.7577/formakademisk.1825

Lyon, T. P. & Montgomery, A. W. (2013). Tweetjacked: The impact of social media on corporate greenwash. *Journal of Business Ethics*, *118*(4), 747–757. https://doi.org/10.1007/s10551-013-1958-x

Løkvik, C. & Reitan, J. B. (2017). Understanding sustainability through making a basic t-tunic in primary school. In A. Berg, E. Bohemia, L. Buck, T. Gulden, A. Kovacevic & N. Pavel (Eds.), *DS 88: Proceedings of the 19th International Conference on Engineering and Product Design Education (E&PDE17), Building Community: Design Education for a Sustainable Future, Oslo, Norway, 7 & 8 September 2017* (pp. 158-163). Glasgow, UK: Design Society. Retrieved from https://www.designsociety.org/publication/40306/UNDERSTANDING+SUSTAINABILITY+THROUGH+MAKING+A+BASIC+T-TUNIC+IN+PRIMARY+SCHOOL

Maus, I. G. (2017). Developing holistic understanding in design education for sustainability. In A. Skjerven & J. B. Reitan (Eds.), *Design for a sustainable culture: Perspectives, practices and education* (pp. 157–170). Abingdon, UK: Routledge.

Maus, I. G. (2019a). Developing design literacy for sustainability: Lower secondary students' life cycle thinking on their craft-based design products. *FormAkademisk – Research Journal for Design and Design Education*, *12*(1), 1–18. https://doi.org/10.7577/formakademisk.1725

Maus, I. G. (2019b). Enhancing design literacy for sustainability among youth in crafts-based design education. *Techne Series – Research in Sloyd Education and Craft Science A, 26*(1), 93–108. https://journals.hioa.no/index.php/techneA/article/view/2851

Maxwell, J. A. (2006). Literature reviews of, and for, educational research: A commentary on Boote and Beile's 'Scholars before researchers'. *Educational Researcher, 35*(9), 28–31. https://doi.org/10.3102/0013189X035009028

Maxwell, J. A. (2010). Using numbers in qualitative research. *Qualitative Inquiry, 16*(6), 475–482. https://journals.sagepub.com/doi/pdf/10.1177/1077800410364740

McDonough, W. & Braungart, M. (2009). *Cradle to cradle: Remaking the way we make things*. London, UK: Vintage Books.

McDonough, W. & Braungart, M. (2013). *The upcycle: Beyond sustainability—designing for abundance*. New York, NY: Melcher Media/North Point Press.

McKernan, J. (2008). *Curriculum and imagination: Process theory, pedagogy and action research*. Abingdon, UK: Routledge.

McNiff, J. (2013). *Action research: Principles and practice* (3 ed.). Abingdon, UK: Routledge.

McNiff, J. (2014). *Writing and doing action research*. London, UK: Sage.

Meadows, D. H., Meadows, D. L., Randers, J., & Behrens III, W. W. (1972). *The limits to growth: A report for The Club of Rome's project on the predicament of mankind*. London, UK: Earth Island

Melkild, N. J. B. (2016). *Forbruk, miljø og bærekraft i utvalgte norske strategidokumenter om utdanning (2004– 2015) – Utfordringer for Kunst og håndverksfaget.* [Consumption, environment and sustainability in selected Norwegian documents on strategies in education (2004–2015) — Challenges for the school subject Art and Crafts] (Master's thesis, Oslo and Akershus University College of Applied Sciences [HiOA], Norway). Retrieved from http://hdl.handle.net/10642/3350

Michl, J. (2002). On seeing design as redesign: An exploration of a neglected problem in design education. *Scandinavian Journal of Design History, 12*, 7–23.

National Committee for Research Ethics in the Social Sciences and the Humanities (NESH) (2016). *Guidelines for research ethics in the social sciences, humanities, law and theology*. Retrieved from https://www.etikkom.no/globalassets/documents/english-publications/60127_fek_guidelines_nesh_digital_corr.pdf

Nielsen, L. M. (2008a). Designdidaktisk forskning i utvikling – en forskningsoversikt 1997–2007 [Design educational research in development – a research review 1997–2007]. *FormAkademisk - Research Journal of Design and Design Education, 1*(1), 19–27. http://dx.doi.org/10.7577/formakademisk.118

Nielsen, L. M. (2008b). Art, Design and Environmental Participation. Themes in Norwegian Studies 1995–2007. In L. Lindström (Ed.), *Nordic Visual Arts Education in Transition: A Research Review* (pp. 127–145). Stockholm: Swedish Research Council. Retrieved from https://www.vr.se/download/18.2412c5311624176023d25583/1529480558949/Nordic-Visual-Arts-Education-in-Transition_VR_2008.pdf

Nielsen, L. M. (2009). *Fagdidaktikk for Kunst og håndverk — i går, i dag, i morgen* [Art and crafts education: yesterday, today, tomorrow]. Oslo, Norway: Universitetsforlaget.

Nielsen, L. M. & Brænne, K. (2013). Design literacy for longer lasting products. *Studies in Material Thinking, 9*, 1–9. https://www.materialthinking.org/papers/125

Nielsen, L. M., Brænne, K., & Maus, I. G. (2015). Design Learning for Tomorrow – Design Education from Kindergarten to PhD (Editorial). *FormAkademisk - Research Journal of Design and Design Education, 8*(1), 1–5. https://doi.org/10.7577/formakademisk.1409

Nielsen, L. M. & Digranes, I. (2007). User participation – real influence or hostage taking? In E. Bohemia, K. Hilton, C. McMahon, & A. Clarke (Eds.), *DS 43: Proceedings of E&PDE 2007, the 9th international conference on engineering and product design education, University of Northumbria, Newcastle, UK, 13.–14.09.2007* (pp. 305–310). Glasgow, UK: Design Society. Retrieved from https://www.designsociety.org/publication/28412/User+participation+-+real+influence+or+hostagetaking%3F

Nielsen, L. M. & Digranes, I. (2012). Designkompetanse i et gjennomgående utdanningsløp [Design competence in a thorough educational pathway]. *Techne Series – Research in Sloyd Education and Craft Science A, 19*(1), 17–24. https://journals.hioa.no/index.php/techneA/article/view/394

Norwegian Centre for Research Data (NSD) (2019). Notify projects that will process personal data. Retrieved from https://nsd.no/personvernombud/en/index.html

Næss, P. (2016). Built environment, causality and urban planning. *Planning Theory & Practice, 17*(1), 52–71. https://doi.org/10.1080/14649357.2015.1127994

Odegard, N. (2012). When matter comes to matter – working pedagogically with junk materials. *Education Inquiry, 3*(3), 387–400. https://doi.org/10.3402/edui.v3i3.22042

Ongstad, S. (2014). Driften i literacy-begrepet — en utfordring for lærerutdanningers fagdidaktikk? [Changes in the concept literacy – A challenge for education teacher training?] In B. Kleve, S. Penne, & H. Skaar (Eds.), *Literacy og fagdidaktikk i skole og lærerutdanning* [Literacy and education in school and teacher education] (pp. 197-224). Oslo, Norway: Novus.

Orheim, M. S. & Nielsen, L. M. (2017). Redesign of garments in general education: A path to reduced consumption. In A. Berg, E. Bohemia, L. Buck, T. Gulden, A. Kovacevic & N. Pavel (Eds.), *DS 88: Proceedings of the 19th International Conference on Engineering and Product Design Education (E&PDE17), Building Community: Design Education for a Sustainable Future, Oslo, Norway, 7 & 8 September 2017* (pp. 405-410). Glasgow, UK: Design Society. Retrieved from https://www.designsociety.org/publication/40347/REDESIGN+OF+GARMENTS+IN+GENERAL+EDUCATION%3A+A+PATH+TO+REDUCED+CONSUMPTION

Pacione, C. (2010). Evolution of the mind: A case for design literacy. *Interactions, 17*(2), 6–11. doi:10.1145/1699775.1699777

Packard, V. (1960). *The waste makers*. New York: McKay.

Papanek, V. (1985). *Design for the real world: Human ecology and social change* (2nd ed.). London: Thames and Hudson.

Royal Ministry of Education, Research and Church Affairs (1999). *The curriculum for the 10-year compulsory school in Norway.* Oslo, Norway: National Centre for Educational

Resources. Retrieved from http://urn.nb.no/URN:NBN:no-nb_digibok_2010032503005

Schön, D. A. (1991). *The reflective practitioner: How professionals think in action* (2nd ed.). Farnham, UK: Ashgate.

Sevaldson, B. (2013). Systems oriented design: The emergence and development of a designerly approach to address complexity. In J., B. Reitan, P. Lloyd, E. Bohemia, L. M. Nielsen, I. Digranes & E. Lutnæs (Eds.), *Design learning for tomorrow – Design education from kindergarten to PhD: Proceedings from the 2nd international conference for design education researchers, 14–17 May 2013, Oslo, Norway* (Vol. 4, pp. 1765–1786). Oslo, Norway: ABM-media.

Simon, H. A. (1996). *The Sciences of the Artificial* (3rd ed.). Cambridge, MA: MIT Press.

Sinnes, A. T. (2015). *Utdanning for bærekraftig utvikling: Hva, hvorfor og hvordan?* [Education for sustainable development: What, why and how?]. Oslo, Norway: Universitetsforlaget.

Skjerven, A. (2017). Design research: Contents, characteristics and possible contributions for a sustainable society. In A. Skjerven & J. B. Reitan (Eds.), *Design for a sustainable culture: Perspectives, practices and education* (pp. 19–28). Abingdon, UK: Routledge.

Spangenberg, J. H., Fuad-Luke, A. & Blincoe, K. (2010). Design for sustainability (DfS): The interface of sustainable production and consumption. *Journal of Cleaner Production, 18*(15), 1485–1493. https://doi.org/10.1016/j.jclepro.2010.06.002

Stahel, W. (2010). Durability, function and performance. In T. Cooper (Ed.), *Longer lasting products: Alternatives to the throwaway society* (pp. 157–177). Farnham, UK: Gower.

Stegall, N. (2006). Designing for sustainability: A philosophy for ecologically intentional design. *Design Issues, 22*(2), 56–63. http://www.mitpressjournals.org/doi/pdf/10.1162/desi.2006.22.2.56

Steinkjer, B. (2015). *Designkompetanse for en bærekraftig fremtid* [Design competence for a sustainable future]. (Master's thesis, Oslo and Akershus University College of Applied Sciences [HiOA], Oslo, Norway), Retrieved from http://hdl.handle.net/10642/2655

Stenhouse, L. (1975). *An introduction to curriculum research and development*. London: Heinemann.

Strandbakken, P. (2007). *Produktlevetid og miljø muligheter og hindringer for en refleksiv økologisk modernisering av forbruket; en teoretisk og empirisk undersøkelse* [Products lifespan and environmental possibilities and hindrances for a reflexive ecological modernisation of consumption, a theoretical and empirical inquiry]. Oslo, Norway: National Institute for Consumer Research (SIFO). Retrieved from http://www.sifo.no/files/file79009_fagrapport2007-7_produktlevetid_og_miljo-web.pdf

Sung, K. & Cooper, T. (2015). Sarah Turner – Eco-artist and designer through craft-based upcycling. *Craft Research, 6*(1), 113–122. https://doi.org/10.1386/crre.6.1.113_1

United Nations (UN) (2015). Transforming our world: The 2030 agenda for sustainable development. Retrieved from http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

United Nations Conference on Environment & Development (UNCED) (1992). *Agenda 21*. Retrieved from https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf

United Nations Educational, Scientific and Cultural Organization (UNESCO) (1997). *Educating for a sustainable future: A transdisciplinary vision for concerted action*. Retrieved from: https://unesdoc.unesco.org/ark:/48223/pf0000110686?posInSet=1&queryId=N-EXPLORE-9f873f3b-1992-4db7-a5d7-8e67755c5745

United Nations Educational, Scientific and Cultural Organization (UNESCO), Education Sector. (2004). *The plurality of literacy and its implications for policies and programmes*. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000136246/PDF/136246eng.pdf.multi

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2005a). *United Nations Decade of Education for Sustainable Development (2005–2014): International Implementation Scheme* Retrieved from: http://unesdoc.unesco.org/images/0014/001486/148654e.pdf

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2005b). *Education for all: Literacy for life*. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000141639

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2012). *Education for Sustainable Development: Sourcebook*. Retrieved from: http://unesdoc.unesco.org/images/0021/002163/216383e.pdf

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2014a). *Shaping the Future We Want: UN Decade of Education for Sustainable Development (2005–2014). Final report*. Retrieved from: http://unesdoc.unesco.org/images/0023/002301/230171e.pdf

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2014b). *UNESCO Education Strategy 2014–2021*. Retrieved from: https://unesdoc.unesco.org/ark:/48223/pf0000231288

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2016). *Education for people and planet: Creating sustainable futures for all, Global education monitoring report, 2016.* Retrieved from: https://unesdoc.unesco.org/ark:/48223/pf0000245752

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2018). *Issues and Trends in Education for Sustainable Development*. Retrieved from: https://unesdoc.unesco.org/ark:/48223/pf0000261445

United Nations Environment Programme (UNEP) (2010). *Here and now! Education for Sustainable consumption: Recommendations and Guidelines*. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/8011/-Here%20and%20now!%20education%20for%20sustainable%20consumption_%20recommendations%20and%20guidelines-2010Here_and_Now_English.pdf?sequence=5&isAllowed=y,%20Chinese||https://wedocs.unep.org/bitstream/handle/20.5

Utdanningsdirektoratet [The Norwegian Directorate for Education and Training] (2006a). *Læreplan i Kunst og Håndverk* (KHV1-01) [Arts and Crafts subject curriculum]. Oslo,

Norway: Retrieved from https://www.udir.no/laring-og-trivsel/lareplanverket/finn-lareplan/lareplan/?kode=KHV1-01

Utdanningsdirektoratet [Norwegian Directorate for Education and Training] (2006b). *Bærekraftig utvikling: Utdanning for bærekraftig utvikling* [Sustainable development: Education for sustainable development]. Retrieved from https://www.miljolare.no/info/Barekraftig_utvikl_rapp.pdf

Utdanningsdirektoratet [The Norwegian Directorate for Education and Training] (2012). *Læreplan i valgfaget design og redesign* (DOR1-01) [Optional course design and redesign subject curriculum]. Retrieved from https://www.udir.no/kl06/DOR1-01/Hele/Komplett_visning

Utdanningsdirektoratet [The Norwegian Directorate for Education and Training] (2013). *Læreplan i naturfag* (NAT1-03) [Nature science subject curriculum]. Retrieved from https://www.udir.no/kl06/NAT1-03/Hele/Hovedomraader

Utdanningsdirektoratet [The Norwegian Directorate for Education and Training] (2018). *Overordnet del av læreplanverket* [Core curriculum: Values and principles for primary and secondary education and training]. Retrieved from https://www.udir.no/laring-og-trivsel/lareplanverket/overordnet-del/

Utdanningsdirektoratet [The Norwegian Directorate for Education and Training] (2019). *Læreplaner i Kunst og Håndverk* (KHV01-02) [Arts and Crafts subject curriculum]. Retrieved from https://www.udir.no/lk20/khv01-02

Veiteberg, J. (2011). Funne og ferdiglaga ting: Oppvinning som kunstnarleg strategi [Found and readymade objects: Upcycling as a strategy in art]. In J. Veiteberg (Ed.), *Ting Tang Trash: Oppvinning i samtidskeramikken* [Objects and trash: Upcycling in contemporary ceramics] (pp. 8–27). Norway: Kunsthøgskolen i Bergen & Kunstmuseene i Bergen.

Vezzoli, C. & Manzini, E. (2008). *Design for environmental sustainability*. London: Springer.

Walker, S. & Giard, J. (Eds.) (2013). *The handbook of design for sustainability*. London: Bloomsbury.

World Commission on Environment and Development (WCED) (1987). *Our common future*. Retrieved from http://www.un-documents.net/our-common-future.pdf

Østergaard, E., Dahlin, B., & Hugo, A. (2008). Doing phenomenology in science education: A research review. *Studies in Science Education, 44*(2), 93–121: http://dx.doi.org/10.1080/03057260802264081

Özsoy, V. (2016). Arts and Design Education for Sustainable Development. *Global Journal on Humanities & Social Sciences* (3), 487–497. Retrieved from https://un-pub.eu/ojs/index.php/pntsbs/article/view/335/pdf

Appendix

Spørsmål om holdninger, kunnskaper, ferdigheter

Halvstrukturert intervjuform (omformuleringer, tilføyelser, utelatelser vil forekomme)

Produktet, produksjonen og bruken av produktet

1. Produktet
   a) Hva har du laget?
   b) Hvilke håndverksteknikker og verktøy brukte du? Synes du at det gikk greit, at du fikk det til?
2. Materialer og produktets livsløp:
   a) Hvilke materialer er produktet ditt laget av?
   b) Egner materialene seg til det produktet skal brukes til?
   c) Vet du hvor i naturen materialene kommer fra /hva det er laget av?
   d) Vet du om dette er en kilde som fornyer seg eller om det er ressurs som brukes opp?
   e) Vet du om det skader naturen å utvinne disse materialene?
   f) Hvordan tror du det er å jobbe med å utvinne disse materialene?
   g) Vet du hvor materialene blir av når du kaster produktet? Kan de brukes til noe annet gjenvinnes, komposteres til jord, forbrennes?
   h) Vet du om materialene er giftige?
   i) Har du hørt om livsløpet til en ting, vet du hva det er? (fra materialer utvinnes, til de blir til jord, blir brent eller til et nytt produkt)
   j) Vet du om materialene er importert fra en annen del av verden, eller om det kommer fra områder i nærheten/ er de kortreiste?
   k) Fortalte læreren om materialene/sto det på materialet/innpakningen?
   l) Opplevde du at dere sløste mye med materialene, ble det mye rester?
   m) Var sløs/det å ikke sløse med materialer noe læreren snakket om?
   n) Lærte dere hvordan dere kan bruke restmaterialer?
3. Konstruksjon:
   a) Hvordan er produktet konstruert/satt sammen?
   b) Er produktet konstruert på en solid måte?
   c) Hvilken del av produktet tror du at vil gå først i stykker?
   d) Kan du reparere produktet hvis det går i stykker? Lærte du om å reparere i undervisningen?
   e) Kommer du til å reparere den når den går i stykker?
   f) Lærte dere hvordan dere kan vedlikeholde tingen?
4. Utforming:
   a) Fulgte du en oppskrift?
   b) Fortalte læreren hvordan du skulle lage den?

c) Tok du noen valg selv, hvilke var det?
d) Har produktet en form som egner seg til det det skal brukes til?
e) Har produktet en form, farge og dekor som du tror at du vil synes at er fin over lang tid? Hvorfor /hvorfor ikke?

5. Forhold til produktet/Forbrukets livsløp/Produktets bruksverdi/ egenverdi/økonomisk verdi:
   a) Hva liker du ved gjenstanden du har laget? Hvorfor det?
   b) Tror du at du kommer til å bruke/ta vare på/ha framme/gi bort dette produktet? Hvorfor/hvorfor ikke?
   c) Er dette en type produkt som man trenger/vil ha mange eller få eksemplarer av?
   d) Var det mer eller mindre arbeid å lage produktet enn du trodde på forhånd?
   e) Hvor mye tror du denne ville koste hvis den var til salgs. Hvor mye blir det i timelønn? Tror du at det er en lønn man kan leve av?
   f) Hva avgjør om man kjøper seg nye ting? Pris, kvalitet (materialer, konstruksjon, utseende), miljøhensyn
   g) Hva påvirker om du tar vare på en ting? Pris, kvalitet (materialer, konstruksjon, utseende), miljøhensyn, gave?
   h) Vet du hvordan du kan vedlikeholde/ta vare på gjenstanden?
6. Produktforbedring: Hvis du skulle lage en ny versjon av produktet:
   a) Er det noe du ikke liker ved gjenstanden du har laget?
   b) Kunne produktet blitt mer solid, hvis du laget det på en annen måte? Hvordan?
   c) Er det noe du ville ha gjort andelenes for at du skulle like produktet bedre over tid?
   d) Hva burde vært gjort annerledes hvis produktet skulle vært mer praktisk til det det skal brukes til?
7. Design
   a) Tror du man kan begrense hvor mye det forurenser å produsere en ting ved å gjøre produksjonen på en smart måte? Har du noen forslag til hvordan?
   b) Tror du man kan begrense hvor mye en ting forurenser når den man brukes og vedlikeholdes, ved å lage den på en smart måte? Forslag til hvordan?
   c) Tror du måten ting er utformet på påvirker om vi tar vare på ting lenge eller kaster dem fort? Eksempler?
   d) Hva er forskjellen mellom et håndlaget produkt som ditt og et produkt som er masseprodusert på fabrikk? Er det ene finere eller mer verdifullt enn det andre? Tar man mer vare på det ene enn det andre? Kaster man lettere det ene enn det andre?
8. Undervisning/Læring:
   a) Hva tror du det var meningen at du skulle lære gjennom å jobbe med denne oppgaven?
   b) Hva lærte du av å lage dette produktet?
      i. Håndverk/verktøyhåndtering?

ii. Utforming? Hva fikk du inntrykk av at læreren synes var viktig i utformingen av denne?

iii. Materialkunnskap?

c) Hva lærte du av det læreren snakket om og viste i undervisningen?

d) Hva lærte du av å fortelle meg om det dere har gjort i undervisningen?

e) Lærte du noe om hvordan du kan ta hensyn til miljøet i arbeidet med å lage denne gjenstanden? Har du noen forslag

f) Hva kunne du tenke deg å lære om hvordan å ta hensyn til miljøet når du lager, kjøper, bruker, vedlikeholder og kaster ting? Hva som er problemene? Hvordan å løse problemene?

g) Tror du at det er lettest å lære om å ta hensyn til miljøet når dere jobber med et konkret eksempel, eller ved generell teoriundervisning?

9. Begrep og bærekraftig design:

a) Vet du hva ordet design betyr? (å skape/skapt: utforming og funksjon)

b) Vet du hva ordet bærekraft betyr? (Økologisk: råvare fra natur / Sosialt: arbeid / Økonomisk: handel)

c) Dette er et kart over ulike måter å lage ting på så de skader miljøet mindre på. Denne måten å jobbe på kalles bærekraftig design. Forklare måter. Er dette forståelig? Er det noen av måtene som er vanskeligere å forså enn andre? Er dette noe du tror at dere kan få til å jobbe med på skolen? Synes du at det er interessant?

SVEIPESKE

– Prosjektbok om produktdesign, håndverk og bærekraft

Navn:

Klasse:

<Sett inn foto av den ferdige esken din her>

ARBEID MED OPPGAVEN

Innledning

- Sveip er en håndverksteknikk som brukes for å lage blant annet runde og ovale oppbevaringsesker i materialet tre.
- Dette er en svært gammel teknikk, som trolig ble brukt i Skandinavia allerede i jernalderen (500 f.kr – 500 e.kr).
- I det gamle bondesamfunnet var det ofte trange kår og derfor helt nødvendig å lage blant annet redskaper og møbler selv. Ved å lære om gamle håndverksteknikker kan vi bli bedre kjent med vår kulturarv. Samtidig er det viktig at vi videreutvikler gamle tradisjoner og lager gode bruksgjenstander med design som passer for vår tid.

Oppgaven

I denne oppgaven skal du:

1. lage en eske i sveipeteknikk.
2. sette sammen skisser, arbeidstegning, foto og svar på spørsmål om arbeidet med utviklingen av esken i denne prosjektboken.

Både esken og prosjektboken skal leveres inn og vurderes av læreren. Svar på spørsmål i prosjektboken vil også stipendiaten ta vare på som forskningsdata.

I denne oppgaven jobber vi spesielt med med:

- håndverksteknikk, materialbearbeiding og verktøyhåndtering.
- valg av utforming, materialer, konstruksjon og håndverksmessig utføring som reduserer produkters negative påvirkning på miljøet.

SVEIP - FRAMGANGSMÅTE

1. Mal til sveip

a) Lim sponplater oppå hverandre til en blokk som er litt høyere enn bredden på sveipfinéren.

b) Tegn formen som esken skal få på et ark. Formen må være en symmetrisk oval eller sirkel.

c) Klipp ut formen, tegn den over på blokken og sag den ut.

2. Sveip

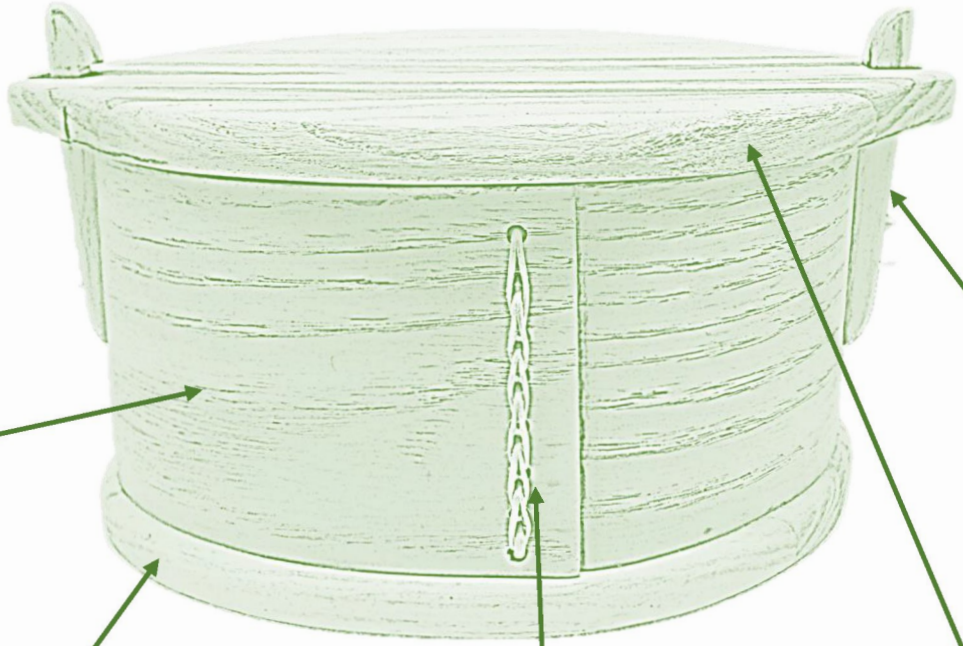
a) Sag sveipfinéren i riktig lengde. Finéren skal være like langt som omkretsen på malen + ca. 10 cm til overlapping.

b) Tegn opp og skjær ut en dekorativ form i den ene enden på finéren og puss enden godt med sandpapir.

c) Legg sveipfinéren i vann over natten og hell så kokende vann over finéren, slik at den blir mykt. Bøy finéren rundt malen, fest med en tvinge og la treverket tørke. Lim skjøten der finérendene overlapper hverandre når treverket er tørt.

d) Puss finéren godt så kantene er plane og overflaten er glatt og uten fliser.

e) Tegn på prikker med 1 cm mellomrom langs overlappingen av sveipen og bor hull.



3. Bunnplate

a) Lim sammen trestaver til en plate og høvle platen rett (læreren høvler platen for deg på høvelmaskinen).

b) Tegn sveipens form på platen og legg til 1 cm i ytterkant. Sag ut formen, rasp og puss kanten jevn.

c) Lim bunnplaten på sveipen og fest denne med en tvinge til limet er tørt.

4. Dekorsøm

a) Bruk peddig eller skinnsnor til å sy en dekorsøm i hullene langs overlappingen.

5. Lokk

a) Tegn formen til lokket på et ark. Denne skal ha ca. samme størrelse som bunnplaten og en form som passer esken. Legg til litt der stavene skal holde lokket på plass. Klipp ut malen og tegn denne over på en plate.

b) Sag ut lokket og puss kantene godt.

6. Staver

a) Tegn en mal til stavene på et ark. Formen på stavene skal passe til esken. Tegn formen over på treplaten, sag ut og puss kantene glatte.

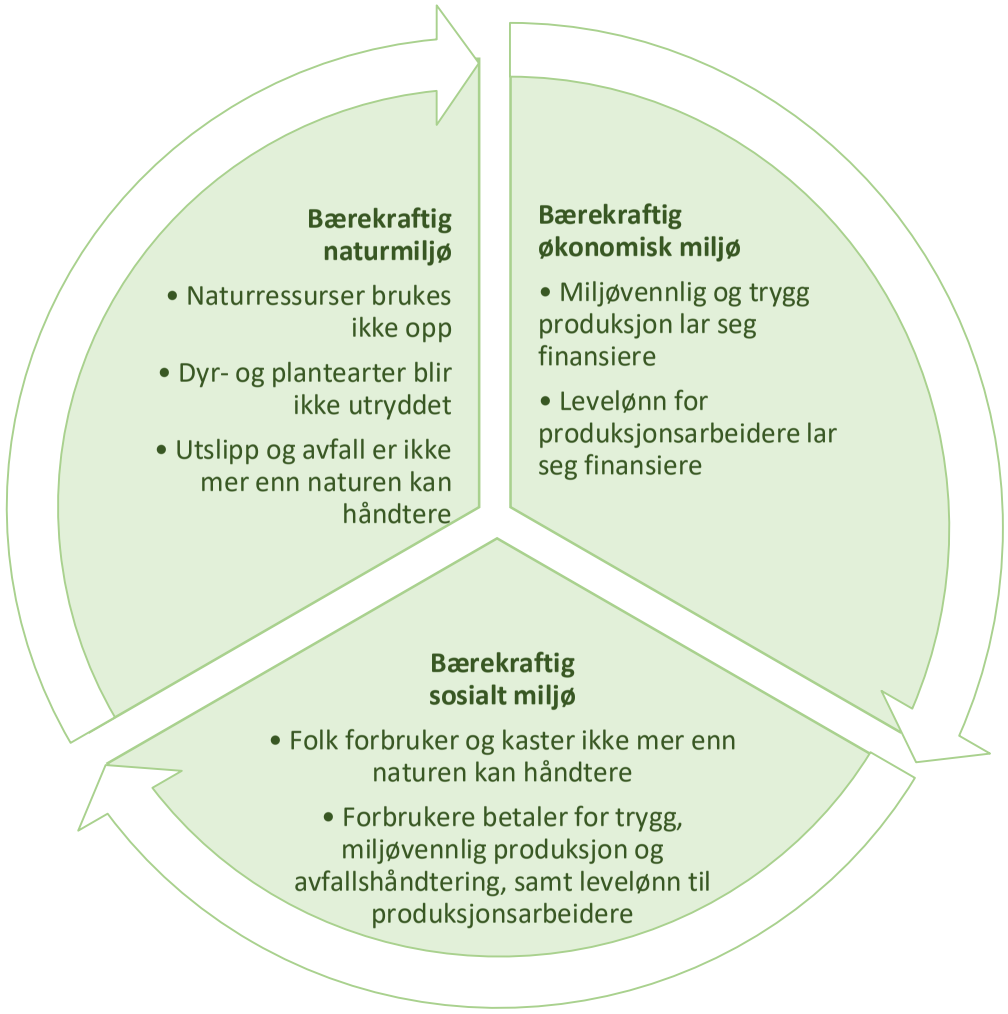
b) Lim stavene fast og la limet tørke.

c) Bore 2-3 hull gjennom staven. Plugg disse med blomsterpinne.

7. Olje esken

a) Hvis esken skal brukes til oppbevaring av mat må du bruke en olje som er giftfri og som ikke utvikler harsk lukt eller smak.

DESIGN OG BÆREKRAFT



Bærekraftig design:

- er utvikling av produkter som vi har bruk for, uten å ødelegge for at mennesker i fremtiden skal kunne lage ting som de har bruk for.
- bruker materialer, konstruksjonsmåter, former og farger som fremmer bærekraftig livsstil, for eksempel ved å redusere bruk og kast.
- buker materialer, produksjonsmetoder og konstruksjonsmåter som ikke bruker opp naturressurser, utrydder plante- og dyrearter, og som forurenser og forsøpler minst mulig gjennom produktets livsløp, fra utvinning av råvarer til produksjon, bruk og gjenvinning.

Bakgrunn – Dagens forbruk er ikke bærekraftig:

- I 2014 kastet Norges 5,1 millioner innbyggere tilsammen 2,3 millioner tonn husholdningsavfall og leverte 15 155 000 kg tekstiler til Fretex.
- Vi betaler ofte så lite for varer at det ikke kan dekke miljøvennlig produksjon eller lønn som produksjonsarbeidere kan leve av.
- Flere mennesker skal dele på ressursene i årene framover. Verdens befolkning vil stige fra 7,3 milliarder i år 2015 til ca. 11,2 milliarder i år 2100.

Kunnskap om hva som gjør at produkter fungerer godt og varer lenge kan hjelpe oss til å forbruke mindre.

1 FUNKSJONELL UTFORMING

Praktisk form

Upraktiske ting som ikke passer eller fungerer til det de skal brukes til blir fort skiftet ut med nye. Dette skaper unødig mye bruk og kast.

Tradisjonelt sett har sveipesker blitt brukt til oppbevaring av mindre plagg, pyntegjenstander og matpakker.

Hva tenker du at skal oppbevares i esken din?

Hvordan har du tilpasset eskens form og størrelse slik at den skal passe til det som skal oppbevares i den?

<Sett inn foto/skann av arbeidstegning til esken din her.>

2 TRADISJONELL UTFORMING, UNIKE DETALJER

Utseende

Ting vi ikke liker utseende på eller vi ikke har et personlig forhold til blir fort skiftet ut med nye.

Tradisjonelt utforming

Sveipede esker med den karakteristiske overlappingen oppfatter vi ofte gjerne som tradisjonelle, fordi teknikken har vært mye brukt i vår kultur helt siden jernalderen (ca. 500 f.kr-500 e.kr).

Unike detaljer

Sveipede esker er ofte dekorert med detaljer som er tilpasset hver enkelt eske. Disse er gjerne preget av hva som er moderne i tiden som esken er laget i.

- I middelalderen (1050-1536) var utkåret dyreornamentikk (treskurd) populært og på 1700-tallet var utskåret geometriske mønstre (karveskurd) populært.
- Siden midten av 1900-tallet har få og enkle detaljer som fremhever materialet, sammenføyninger og funksjoner som lukkemekanismer ol. har vært populært i nordisk design.

Beskriv hvordan du har gitt esken din unike detaljer:

<Sett inn foto/skisser av detaljer på esken din her>

3 NØYAKTIG HÅNDVERK

Håndverksmessig utføring

Nøyaktig utført håndverk gir esken et profesjonelt uttrykk.

Fortell hvilke deler av håndverket du synes at du fikk til å utføre på en nøyaktig måte?

Er det noen deler av håndverket du synes du at du kunne ha fått til bedre, i tilfelle hvilke?

<Sett inn detaljfoto av håndverket ditt her>

4 MATERIALER MED BÆREKRAFTIG LIVSLØP

Livsløpet til ask og bøk:

1. Utvinning: Ask og bøk er ikke utrydningstruede trearter.
2. Bruk: Ask og bøk er løvtrær som lar seg bøye uten å sprekke opp, fordi de har rett stamme med få kvister. Bøk og ask er harde treslag med lys farge, bøk har litt mer rødlig farge enn ask. Ask og bøk avgir ikke smak og egner seg derfor til matoppbevaring.
3. Etter bruk: Avkapp og tre fra esken kan brukes til å lage andre småting. Avkapp kan også komposteres til jord.

Materialer til sammenføyninger

- Trelim holder sammen overlappingen i sveipet, fester sveipet til bunnplaten og stolpene til sidene av esken. Trelimet inneholder plasten PVAC (Polyvinylacetat) som ikke er biologisk nedbrytbar.
- Sømmen som styrker sammenføyningen av sveipen sys i lærsnor eller peddig.

Materiale til overflatebehandling

- Olje som hindrer at treverket tar til seg flekker, tørker ut og sprekker opp. På produkter til tilbereding og oppbevaring av mat må vi bruke en olje som er godkjent til dette. Disse oljene utvikler ikke harsk lukt eller smak og de er giftfrie.

Hvilket treslag valgte du til esken din?

Hvilke materialer har du brukt til sammenføyning og hvilke fordeler er det ved bruk av disse sammenføyningsmaterialene?

Kan esken din komposteres til jord og/eller forbrennes og bli til strøm eller fjernvarme?

<Sett inn tegningen din av ask eller bøk her.
Har du ikke laget tegningen kan du sette inn et foto av treverket>

5 KONSTRUKSJON, REPARASJON OG VEDLIKEHOLD

Solid konstruksjon

Produkter med en lite solid konstruksjon går fort i stykker og blir kastet.

Reparasjon

Produkter som er vanskelig å reparere blir fortere kastet enn produkter som lett lar seg reparere.

Vedlikehold

Produkter som er vanskelige å vedlikeholde blir dårlig tatt vare på og går fort i stykker.

Hvilke sammenføyninger i esken din er solid konstruert?

Hva tror du at er det svakeste punktet som vil gå lettest i stykker på esken din, og hvordan kan eventuelt en skade der repareres?

Hvordan burde dette svake punktet ha vært konstruert hvis det skulle ha vært mer solid?

Hvordan bør esken din vedlikeholdes?

<Sett inn foto av en sammenføyning i esken din her>

6. VERDI, VAREPRIS, LØNN OG MATERIALKOSTNADER

Varepris som dekker lønn til å leve av og bærekraftig materialproduksjon

Sveipeesker var tidligere masseprodusert på bygda av eskemakere og solgt i byene og på markedene. I dag ansees dette som en husflidsteknikk.

Oppbevaringsesker og andre ting som vi kjøper i dag er ofte produsert i deler av verden hvor lønnsnivået og levekostnadene (prisen på mat og bolig) er lavere enn i Norge. Dette gjør at varer kan selges billigere enn om de var produsert her. Ofte selges varene så billig at det ikke kan finansiere levelønn for produksjonsarbeiderne. Derfor lever mange produksjonsarbeidere i fattigdom.

Varepris skal dekke:

- Lønnskostnader: Varierer fra land til land.
- Produktutvikling: Design av produktet, utvikling av maler ol.
- Produksjonsmetode: Maskinell produksjon går ofte raskere enn håndverk.
- Materialkostnader: Miljøvennlig produksjon av materialer kan være høyrere på kort sikt enn ikke-miljøvennlig produksjon av materialer.
- Andre produksjonskostnader: lokaler, maskiner, strøm og forsikring.
- Distribusjon og salg: transport, lager, butikkdrift og markedsføring.
- Avgifter: arbeidsgiveravgift, merverdiavgift, importavgift mm.

Produksjonskostnader til esken din	
Lønn: 25 arbeidstimer x kr 260 (gjennomsnitts timelønn)	= kr
Materialer	+ kr 100,-
Produksjonskostnad	= kr

Et håndsveipet fat koster ca. kr. 700,- i husflidsbutikk og en liten maskinsveipet sponeske koster ca. kr. 30,- i hobbybutikk.

Hva kan være grunnen til at prisen på disse er så mye lavere enn produksjonskostnadene til esken din?

Affeksjonsverdi – verdi knytt til følelser

Ting som vi knytter minner og følelser til er verdifulle for oss, uavhengig av tingens varepris. Gjenstander som vi har lager selv, fått i gave eller som viser at vi er del av et fellesskap kan ha denne typen verdi.

Skal du beholde esken din selv eller gi den bort?

HVA LÆRTE DU I ARBEIDET MED DENNE OPPGAVEN?

Håndverk
Hva synes du at du lærte om håndverksteknikk, materialbearbeiding og verktøyhåndtering?

Problemløsning for bærekraftig design
Hva synes du at du lærte om valg av utforming, materialer, konstruksjon og håndverksmessig utføring som reduserer produkters negative påvirkning på miljøet?

Nytte av kunnskap om bærekraft og design
I hvilke sammenhenger tror du at du kan ha nytte av å kunnskap om bærekraft og design?

Vanskelig?
Var det noe du synes at du ikke forsto eller fikk til av det du jobbet med, i tilfelle hva?

MÅL FRA LÆREPLANEN I KUNST OG HÅNDVERK

Hovedområde design

I design står formgiving av gjenstander sentralt. Her videreføres håndverkstradisjonen i faget. Design omfatter både arbeid direkte i materialer og arbeid med skisser og modeller. Utforming av ideer, arbeidstegninger, produkter og bruksformer står sentralt. Kjennskap til materialer, problemløsning og produksjon kan danne grunnlag for innovasjon og entreprenørskap.

Grunnleggende ferdigheter:

- uttrykke seg skriftlig
- uttrykke seg muntlig
- regne
- bruke digitale verktøy

Kompetansemål for opplæringen er at eleven skal kunne:

- lage funksjonelle bruksgjenstander og vurdere kvaliteten på eget håndverk
- designe produkter ut fra en kravspesifikasjon for form og funksjon
- beskrive ulike løsningsalternativer i design av et produkt ved hjelp av skisser og digital programvare
- beskrive livsløpet til et produkt og vurdere konsekvenser for bærekraftig utvikling, miljø og verdiskaping
- skape […] og drøfte […], pris og kvalitet i et forbrukerperspektiv

VURDERINGSKRITERIER FOR DENNE OPPGAVEN

Mål	Lav måloppnåelse	Middels måloppnåelse	Høy måloppnåelse
Bruke skisser som metode for å utvikle ideer til eskens form, dekor og detaljer.	Jeg har tegnet få skisser	Jeg har tegnet skisser som illustrerer noen ulike ideer	Jeg har brukt skisser som metode for å utvikle ideer til eskens form, dekor og detaljer.
Planlegge eskens størrelse og form slik at den passer til det som skal oppbevares.	Jeg har valgt en størrelse og form til esken. Den passer i mindre grad til det som skal oppbevares.	Jeg har tilpasset eskens størrelse og form slik at den passer nokså bra til det som skal oppbevares.	Jeg har tilpasset eskens størrelse og form slik at den passer til det som skal oppbevares.
Planlegge arbeidet ved å tegne en nøyaktig arbeidstegning.	Jeg har tegnet en nokså unøyaktig arbeidstegning	Jeg har tegnet en stort sett nøyaktig arbeidstegning av esken sett forfra	Jeg har tegnet en nøyaktig arbeidstegning av esken sett forfra med utfyllende detaljer.
Utføre godt håndverk i arbeid med å lage eske	Jeg har tatt i bruk noen redskaper og har laget en eske som viser en del unøyaktig arbeid.	Jeg har brukt redskaper på en hensiktsmessig måte, og har arbeidet nokså nøyaktig med esken.	Jeg har brukt redskaper på en hensiktsmessig måte, og har arbeidet nøyaktig slik at esken ser helhetlig og gjennomarbeidet ut.
Kunne reflektere og vurdere konsekvenser av bærekraftig design	Jeg viser mindre forståelse og refleksjon for bærekraftig design.	Jeg viser en del forståelse og refleksjon for bærekraftig design.	Jeg viser stor grad av forståelse og refleksjon for bærekraftig design.

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Ingvill Gjerdrum Maus
Institutt for estetiske fag Høgskolen i Oslo og Akershus
Postboks 4, St. Olavs plass
0130 OSLO

Vår dato: 14.07.2014 Vår ref: 39214 / 3 / SSA Deres dato: Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 03.07.2014. Meldingen gjelder prosjektet:

39214	*Design Literacy for Sustainable Design*
Behandlingsansvarlig	*Høgskolen i Oslo og Akershus, ved institusjonens øverste leder*
Daglig ansvarlig	*Ingvill Gjerdrum Maus*

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/meldeplikt/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 01.08.2018, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Vigdis Namtvedt Kvalheim

Sondre S. Arnesen

Kontaktperson: Sondre S. Arnesen tlf: 55 58 33 48
Vedlegg: Prosjektvurdering

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 39214

Utvalget informeres skriftlig og muntlig om prosjektet og samtykker til deltakelse. Informasjonsskrivet er godt utformet.

Personvernombudet legger til grunn at forsker etterfølger Høgskolen i Oslo og Akershus sine interne rutiner for datasikkerhet. Dersom personopplysninger skal sendes elektronisk , bør opplysningene krypteres tilstrekkelig.

Forventet prosjektslutt er 01.08.2018. Ifølge prosjektmeldingen skal innsamlede opplysninger da anonymiseres. Anonymisering innebærer å bearbeide datamaterialet slik at ingen enkeltpersoner kan gjenkjennes. Det gjøres ved å:
- slette direkte personopplysninger (som navn/koblingsnøkkel)
- slette/omskrive indirekte personopplysninger (identifiserende sammenstilling av bakgrunnsopplysninger som f.eks. bosted/arbeidssted, alder og kjønn)
- slette lyd- og videoopptak

Appendix 4: NSD research ethical approval 2, on interviews and action research with students and teachers

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
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nsd@nsd.uib.no
www.nsd.uib.no
Org.nr: 985 321 884

Ingvill Gjerdrum Maus
Institutt for estetiske fag Høgskolen i Oslo og Akershus
Postboks 4, St. Olavs plass
0130 OSLO

Vår dato: 28.01.2015 Vår ref: 41630 / 3 / MSS Deres dato: Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 15.01.2015. Meldingen gjelder prosjektet:

41630	*Design Literacy for Sustainable Design*
Behandlingsansvarlig	*Høgskolen i Oslo og Akershus, ved institusjonens øverste leder*
Daglig ansvarlig	*Ingvill Gjerdrum Maus*

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/meldeplikt/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 01.08.2018, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Katrine Utaaker Segadal

Marie Strand Schildmann

Kontaktperson: Marie Strand Schildmann tlf: 55 58 31 52
Vedlegg: Prosjektvurdering

Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 41630

Prosjektet gjennomføres i samarbeid med Høgskolen i Volda, Høgskolen i Telemark, Arkitektur-og designhøgskolen i Oslo, Universitetet i Oslo. Høgskolen i Oslo og Akershus er behandlingsansvarlig institusjon. Personvernombudet forutsetter at ansvaret for behandlingen av personopplysninger er avklart mellom institusjonene. Vi anbefaler at det inngås en avtale som omfatter ansvarsfordeling, ansvarsstruktur, hvem som initierer prosjektet, bruk av data og eventuelt eierskap.

Utvalget består av lærere og elever knyttet til designundervisning i skolen. Prosjektet er utformet som aksjonsforskning og datamaterialet innhentes gjennom intervju av lærere, samt gruppeintervju, observasjon av undervisningssituasjoner og evaluering via spørreskjema blant elevene.

Utvalget rekrutteres via skoler som ønsker å delta. Elever og foreldre informeres skriftlig og muntlig om prosjektet og samtykker til deltakelse. Informasjonsskrivet er godt utformet, men det må fremgå tydelig at datamaterialet skal anonymiseres. Slik skrivet nå er formulert fremgår det at kun kontaktopplysninger skal slettes. Dersom datamaterialet ikke skal anonymiseres ved prosjektslutt må det innhentes eksplisitt samtykke til dette, og altså fremgå av informasjonsskrivet/forespørselen.

Ombudet anbefaler at det tydeliggjøres hvorvidt elever som ikke ønsker å delta (filmes) får alternativ undervisning, eller på annet vis skjermes fra registreringen.

Det forutsettes at lærere som skal inngå i forskningsprosjektet mottar tilsvarende informasjon om prosjektet, hva deltakelsen innebærer og at det er frivillig å delta i forskningsprosjektet.

Revidert informasjonsskriv stilet til foreldre/barn skal sendes til personvernombudet@nsd.uib.no før utvalget kontaktes.

Personvernombudet legger til grunn at forsker etterfølger Høgskolen i Oslo og Akershus sine interne rutiner for datasikkerhet. Dersom personopplysninger skal lagres på mobile enheter, bør opplysningene krypteres tilstrekkelig.

Det benyttes en transkribent i prosjektet. Dersom transkribent ikke har et ansettelseesforhold ved Høgskolen i Oslo og Akershus skal det inngås skriftlig avtale mellom høgskolen og transkribent om hvordan personopplysninger skal behandles, jf. personopplysningsloven § 15. For råd om hva databehandleravtalen bør inneholde, se Datatilsynets veileder: http://www.datatilsynet.no/Sikkerhet-internkontroll/Databehandleravtale/.

Forventet prosjektslutt er 01.08.2018. Ifølge prosjektmeldingen skal innsamlede opplysninger da anonymiseres. Anonymisering innebærer å bearbeide datamaterialet slik at ingen enkeltpersoner kan gjenkjennes. Det gjøres ved å:
- slette direkte personopplysninger (som navn/koblingsnøkkel)

- slette/omskrive indirekte personopplysninger (identifiserende sammenstilling av bakgrunnsopplysninger som f.eks. bosted/arbeidssted, alder og kjønn)
- slette lyd- og videoopptak

Vi gjør oppmerksom på at også databehandler (Bruk av transkribent kan forekomme) må slette personopplysninger tilknyttet prosjektet i sine systemer. Dette inkluderer eventuelle logger og koblinger mellom IP-/epostadresser og besvarelser.

Prosjektnr: 41630. Design Literacy for Sustainable Design

Lise Aasen Haveraaen <Lise.Haveraaen@nsd.no>
ti. 16.07.2019 14:43
Til: Ingvill Gjerdrum Maus <ingm@oslomet.no>

BEKREFTELSE PÅ ENDRING

Viser til endringsmelding registrert hos NSD 10.07.2019.

Vi har nå registrert at ny dato for prosjektslutt er 31.12.2019.

Vi gjør oppmerksom på at dersom det gjøres ytterligere utvidelser av prosjektperioden, må prosjektet meldes i vårt nye meldeskjema. Dette på grunn av nye dokumentasjonskrav i den nye personopplysningsloven som ble innført 20.07.2018. Ytterligere forlengelser kan ikke påregnes uten at det vurderes å gi informasjon til utvalget. Du finner vårt nye meldeskjema her: https://meldeskjema.nsd.no/

NSD forutsetter at prosjektopplegget for øvrig gjennomføres i tråd med det som tidligere er innmeldt, og våre tilbakemeldinger. Vi vil ta ny kontakt ved prosjektslutt.

Vennlig hilsen
--
Lise Aasen Haveraaen
Seniorrådgiver | Senior Adviser
Seksjon for personverntjenester | Data Protection Services
T: (+47) 55 58 21 19

NSD – Norsk senter for forskningsdata AS | NSD – Norwegian Centre for Research Data
Harald Hårfagres gate 29, NO-5007 Bergen
T: (+47) 55 58 21 17
postmottak@nsd.no www.nsd.no

Appendix 6: Invitation and information letter 1 to teachers, on sharing of design and sustainability school projects

Ingvill Gjerdrum Maus
Stipendiat
Høgskolen i Oslo og Akershus
Fakultet for teknologi, kunst og design
Institutt for estetiske fag
ingvillg.maus@hioa.no

Forespørsel om deltakelse i forskningsprosjektet

Design Literacy for Sustainable Design

Bakgrunn og formål
Formålet med studien er å undersøke potensialet for at elever kan lære om bærekraftig produksjon og bruk av produkter i design, kunst og håndverksundervisning i skolen.

Studien vil undersøke hvordan problemstillinger knytt til bærekraft og design kan bli inkludert undervisningsopplegg. Undersøkelsen vil både se etter elementer i undervisningsmaterialet der temaet bærekraft direkte knyttes til design og elementer der det er potensiale for å knytte temaet bærekraft til design.
Funn fra denne delen av studien vil danne grunnlag for videre studier av elevers læring om bærekraftig produksjon og bruk av produkter design, kunst og håndverksundervisning i skolen.

Prosjektet er et doktorgradsstudie som inngår i det større forskningsprosjektet *Design Literacy — from primary education to university level*. Prosjektet er tilknyttet Høgskolen i Oslo og Akershus, Fakultet for teknologi, kunst og design, Institutt for estetiske fag.

Lærere som underviser i aktuelle fag blir forespurt om de vil delta i forskingsprosjektet gjennom henvendelse fra forskingsprosjektet til skoler og i åpen invitasjon gjennom aktuelle Facebook-grupper.

Hva innebærer deltakelse i studien?
Deltakelse i studien innebærer at du sender oss undervisningsopplegg som omhandler design av produkter som forsøker å ivareta et bærekraftig miljø (økologisk, sosialt eller økonomisk) gjennom måten produktene er produsert på (for eksempel ved bruk av gjenbruksmaterialer) eller måten produktene brukes på (for eksempel ved solid håndverk som gir produkter lang levetid).

Hva skjer med informasjonen om deg?
Alle personopplysninger vil bli behandlet konfidensielt. Kontaktinformasjon om deg (navn, tittel, arbeidsplass, samt adresse, telefonnummer og e-postadresse på arbeidsplassen) vil bli oppbevart separert fra undervisningsmaterialet som du sender inn. Kun prosjektgruppen vil ha tilgang til denne informasjonen. Deltagere i undersøkelsen vil ikke kunne identifiseres i publikasjon av funn fra denne undersøkelsen.
Dersom du samtykker til at prosjektgruppen kan kontakt deg igjen, kan du komme til å bli spurt om du ønsker å delta i videre studier av undervisning om design og bærekraft.

Prosjektet skal etter planen avsluttes 1.8.2018. Kontaktinformasjon om deg vil da bli slettet.

Frivillig deltakelse
Det er frivillig å delta i studien, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn. Dersom du trekker deg, vil alle opplysninger om deg bli anonymisert.

Dersom du ønsker å delta, så legg ved følgende materiale som vedlegg i en e-post til ingvillg.maus@hioa.no:

- Undervisningsopplegg (arbeidsoppgaver, konkretiseringsmateriale mm). Materialet skal ikke inneholde skolens, læreres eller elevers navn.
- Signert samtykke om å delta. Før din kontaktinformasjon på samtykket, dersom prosjektet kan få kontakte deg igjen for eventuelle videre studier.

Spørsmål til studien rettes til Stipendiat Ingvill Gjerdrum Maus på telefon 67 23 85 36 eller e-post ingvillg.maus@hioa.no

Studien er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste AS.

Samtykke til deltakelse i studien

Jeg har mottatt informasjon om studien, og er villig til å delta

Navn:

Tittel:

Skolens navn:

Skolens adresse:

E-post (jobb):

Telefonnummer (jobb):

Dato Signatur

Kryss av i én eller begge svaralternativene nedenfor.

☐ ***Jeg samtykker til at undervisningsmaterialet som jeg sender inn inngår i studien.***

☐ ***Jeg samtykker til at forskningsprosjektet kan kontakte meg med forespørsel om å få studere undervisningen min om design og bærekraft nærmere, hvis det blir aktuelt. Jeg står da fritt til å takke ja eller nei, hvis jeg får en slik forespørsel.***

Appendix 7: Invitation and information letter 2 to teachers, on cooperation in development of craft-based DfS projects

Ingvill Gjerdrum Maus
Stipendiat
Høgskolen i Oslo og Akershus
Fakultet for teknologi, kunst og design
Institutt for estetiske fag
ingvillg.maus@hioa.no

Forespørsel om deltakelse i forskningsprosjektet

Design Literacy for Sustainable Design

Bakgrunn og formål
Formålet med studien er å undersøke potensialet for at elever kan lære om bærekraftig produksjon og bruk av produkter i designundervisning i skolen.

Studien vil undersøke hvordan problemstillinger knytt til bærekraft og design kan bli inkludert undervisningsopplegg, og hvilket læringsutbytte elevene har av dette. Undersøkelsen vil både se etter elementer i undervisningsmaterialet der temaet bærekraft direkte knyttes til design og elementer der det er potensiale for å knytte temaet bærekraft til design.

Prosjektet er et doktorgradsstudie som inngår i det større forskningsprosjektet *Design Literacy — from primary education to university level*. Prosjektet er tilknyttet Høgskolen i Oslo og Akershus, Fakultet for teknologi, kunst og design, Institutt for estetiske fag.

Lærere som underviser i aktuelle fag blir forespurt om de vil delta i forskingsprosjektet gjennom henvendelse fra forskingsprosjektet til skoler og gjennom åpen invitasjon.

Hva innebærer deltakelse i studien?
Deltakelse i studien innebærer at du som lærer og en doktorgradskandidat samarbeider om integrere tematikken bærekraft i undervisningsopplegg som skolen allerede praktiserer.
Doktorgradskandidaten vil bidra med fagkunnskap om bærekraftig design og hjelpe deg med å integrere dette i undervisningsopplegget ditt slik at du kan prøve det ut i klassen. Elevenes læringsutbytte vil så bli undersøkt gjennom intervju med elevene, eventuelt at de gjør en egenevaluering av produktet de har laget og av hva de har lært.
Doktorgradskandidaten vil dokumentere samarbeidet om utviklingen av undervisningsopplegget, utprøvingen i klassen og undersøkelsen av elevenes læringsutbytte gjennom å ta video/lydopptak.

Hva skjer med informasjonen om deg?
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Design Literacy for Sustainable Design

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12 Developing holistic understanding in design education for sustainability

Ingvill Gjerdrum Maus

Sustainable development through design education for young people

Striving towards sustainable cultures is part of the sustainable development that global societies have agreed on (World Commission on Environment and Development, 1987), and in which education is assigned a key role (United Nations Conference on Environment and Development, 1992, §25.14 d and §36). One initiative, led by the United Nations, was to declare 2005–2014 *The Decade of Education for Sustainable Development*. The United Nations Educational, Scientific and Cultural Organization's (UNESCO) final report states that education shall provide learners with knowledge, skills and values to discover solutions to today's sustainability challenges (2014, p. 3). UNESCO's final report note that sustainability is now included in the general goals of education in many countries, but they need to reorient their teacher education towards relevant academic content and learning methods (2014, pp. 30–31).

Norway had already introduced sustainability in its core curriculum for education at all levels in 1993. This was followed by introducing environmental concerns in handcrafting in 1997 (Royal Ministry of Education, Research and Church Affairs, 1999, pp. 9, 51–54, 203–217) and sustainability in products life cycles in 2006 in the curriculum for Arts and Crafts (*Kunst og håndverk* in Norwegian) (Ministry of Education and Research, 2006) – a school subject that comprises art, design, architecture and visual communication at primary and lower secondary level. The environmental issues are not remote to the school subject's tradition of engaging with handcraft by using materials from nature (Nielsen, 2009, pp. 109–112). Though, new is the emphasis on reflection on the relations between products and environmental sustainability.

Design education for sustainability

However, there are areas for lower secondary education to draw on in development of their educational practice. The field of professional design education

has discussed products and environmental sustainability sporadically since the mid-twentieth century and more systematically since the 1980s. The scope of topics in product design innovation has evolved from the reduction of environmental impact from product qualities and from products' life-cycles with the extraction of raw material, production, use and disposal to design for material recycling in biological and technological loops, emotionally durable design, sustainable behaviour and poverty reduction. Nonetheless, broadening the scope of design for sustainability (DfS) has not reduced the importance of designing each product with the minimum environmental impact (Ceschin & Gaziulusoy, 2016). Through this focus, environmental impact has become a quality criterion in design and it has brought forward various strategies in DfS. Minimising the damage of bad design does not immediately make a product sustainable, but design strategies clarify what to expect from the design (McDonough & Braungart, 2013, pp 13, 29). The professional field of design argues for a sharing of this design knowledge, both through product design that encourages participation and competence among the users (Stegall, 2006) and through design learning for all in education (European Design Leadership Board, 2012, pp. 66–71). Even though the perspectives and practices in design education for sustainability are developed to comply with the needs of professional design, they are also relevant to education at lower secondary level.

Professional design education for sustainability is described as education *for* sustainability, not *about* sustainability. Sustainability refers here to the sustainable societies that we aim to achieve through design education. Design refers to development where design is perceived as part of both the problems and the solutions to the over-consumption of resources in the production of goods and in everyday behaviour in societies with unsustainable practices. Education refers to the development of understanding through design work in the studio (Clune, 2010). Clune describes two approaches to design education for sustainability. The first is a master-and-apprentice model that focuses on how to design. The second is a student-centred model where the students are less dependent on the teacher. This model also engages in the definition of problems and what to design and is open to problems to which the teacher does not know the solutions (Clune 2010). Design education at the lower secondary level (13–16-year-old students) has similarities to the master-and-apprentice model, with the focus on *how* to design. Nonetheless, the inclusion of the issues of *what* to design, and of unsolved problems, is essential for their future in a world that is in need of change. The contribution of the students' design education to the development of sustainable societies is substantial. It has the potential of empowering ordinary young citizens for skilled, democratic participation in practical problem solving in their everyday living, studies and future working lives.

Students' points of view as the basis for educational change

The political intentions of education for sustainable development are formalised in the Arts and Crafts curriculum (Ministry of Education and Research, 2006) and practices in design and design education for sustainability are available to draw on. However, changes in education do not only depend on implementation at the ideological level of political intentions and the formal level of the curricula, but also on changes in the perceived and operationalised level among teachers and school leaders, as well as in the experienced level among students (Goodlad et al., 1979, pp. 58–65; Nielsen, 2009, pp. 27–31). UNESCO points to the present needs for development in teacher education (2014, pp. 30–31). This chapter focuses on students' perspectives as the basis for changes in educational practice to enhance understanding in design for sustainability. The starting points for this study are two diverging viewpoints among students on whether the topic of environmental concerns serves the purpose of learning creative and practical work in Arts and Crafts classes.

Students' perspectives

This is a study of students' perspectives on environmental concerns in product design as an educational topic in the school subject of Arts and Crafts. Semi-structured group interviews (Fontana & Frey, 2008) were conducted among seven 10th-grade students (aged 15–16) in a Norwegian lower secondary school in the spring of 2015. The interviews were held with two groups: the first with two female students and the second with three female and two male students. The interviews were part of the preparations for an action research project on the above-mentioned educational topic. The interviews were intended to identify the potential and possible challenges that should be prepared for in the educational activities in the action research. The research project's focus was rooted in studies on designing for sustainability (Stegall, 2006), with a particular emphasis on design for increased product life spans (Cooper, 2005) and design for the circular use of resources (McDonough & Braungart, 2009, 2013). A school that organised its Arts and Crafts education to facilitate the project and provide guidance for students was recruited to participate in the project as a case study. This school organised Arts and Crafts classes in groups comprised of half the size of the classes in most of the other school subjects. The classes were led by teachers with subject specialisations and held in equipped studios. Several of the Arts and Crafts projects were comprehensive and lasted for a full semester. However, the interviewed students had little or no experience with sustainability and environmental concerns as topics in the school subject. Nonetheless, they expressed interest and relevant knowledge on environmental impacts of products and product use during the collaborative reflections on the prepared and the elaborated

interview questions. Their reflections comprised the knowledge they acquired through formal education in Arts and Crafts and other school subjects, as well as through experiences in everyday living and complementary information by other channels. UNESCO defines two categories of other channels for education: unformal education by educators at museums and non-formal education by other channels such as media (UNESCO, 2014, pp. 20, 30–31). In design education for sustainability this distinction is useful because actors have different bases for the information they provide. Interest in promoting a sustainable image that is difficult to fulfil is known to generate misleading information on environmental concerns, known as 'greenwashing' (Boehnert, 2013, pp. 447 and 452; 2015, p. 7).

Two perspectives

The first group of student interviewees had a positive attitude towards learning about environmental concerns in relation to product design in Arts and Crafts. They said that talking about the topic helped their understanding, and they reasoned that their knowledge of it would be useful for both their practical design and handcraft work in school and in their everyday lives. The second group expressed a negative attitude. They reasoned that it was a theoretical topic with key answers, which would disrupt the school subject's purpose of engaging in creative processes and practical design and handcraft work, as well as shift the practice in classes from practical to theoretical work. They trusted in their teacher to make environmentally safe choices on behalf of their design and handcraft projects. They explained their perspectives on students' need for variation in work methods throughout their schooldays, the needs of students who struggle with theoretical work and the needs of students aiming at future professions in handcrafts.

Without delving into the sources to their development of points of view, this chapter will concentrate on a key issue for the operationalisation of design education for sustainability, to clarify how the students' perspectives coincide with the essential elements in educational practice on DfS. To examine this, the study uses the concepts from the German pedagogue Wolfgang Klafki's (1959/2001, 1985/2001) theory of *kategorialen Bildung* as analytical lenses.

Klafki's theory of *kategorialen Bildung*

The close relation between the purposes of education and the selection of educational topics stands as a core topic of discussion in German and Nordic education's theoretical tradition of *Didaktik* [*didaktikk* in Norwegian]. *Didaktik* is a term that originates from the Greek *didaskein*, meaning "to teach", "to be a teacher" or "to educate". The German and the Nordic traditions refer to *Didaktik* as the "art of teaching" or the "study of teaching", which involves a broader discussion than the English term *didactics*, referring to "curriculum and methods" or "curriculum and instruction" (Hopmann & Riquarts, 2000).

In the *Didaktik* tradition, educational topics respond to the purpose of education. This point is particularly made by Klafki, who elaborates that the relation between education's purpose and topics must be perceived not only by the teacher but also by the students (Klafki, 1959/2001, p. 194). This is fundamental for the students' ability to develop through education, a development called *Bildung* [*formation* in English, *danning* in Norwegian] in the German tradition of *Didaktik*. The term *Bildung* has its origin in *Bild* (image), which holds the double meaning of representing both what *is* and what *might be*, thus the idea of transformation (Kouppanou, 2016). *Bildung* refers to students' development in order to participate in the ongoing development of both education and society in general.

Kategorialen Bildung

Within this tradition of *Didaktik* and *Bildung*, Klafki (1959/2001) developed his theory of *kategorialen Bildung*, a foundation for his later works (1985/2001) and an influential concept in the field of *Didaktik* (Hohr, 2011, p. 164). Klafki built his theory on a critique of single-sided views on the purpose of education as either learning of educational content or development of the student. Klafki offers a more holistic view of the purpose of education. He argues that the students' learning of educational content and their development depend on each other and evolve together in educational practice. Therefore, they cannot be considered two separate purposes of education. Rather, the purpose of education is to prepare students to develop in their encounters with educational content. Klafki explains this development as a phenomenon, an experience of the student. It occurs when his or her subjective conditions – such as critical thinking, judgement, will and imagination – unite with objects that culturally represent the world, such as classical culture and scientific knowledge. In this way, understanding constitutes a higher unity than a synthesis of subjective and objective conditions: a holistic understanding. Understanding evolves through engagement with the object. The engagement process opens the subject's general insights and experiences, while the objective opens its general content, clarifying categories as understandable for the subject. Klafki calls this process a double-sided opening, and the experienced phenomenon is *kategorialen Bildung*. *Kategorialen* does not refer to categories for discrimination between alternatives (*differentis specifica*) but to the phenomenon experienced by a student when his or her understanding opens and evolves as categories for him or her (Klafki, 1959/2001).

The purpose of topics

The holistic understanding that evolves when the students' subjective conditions engage with the object of the educational content leads Klafki to argue that the purpose of the educational topics must be grounded in both subjective and objective terms. The students' opening up to the educational

topics depends on their understanding of the topics' significance in their past, present and future lives. However, their perspectives of relevance spring from their horizons of experience. The role of teachers is not only to understand the students' perspectives but also to challenge and expand their points of view and to build bridges between their perspectives on their past, present and future (Hohr, 2011, p. 167; Klafki, 1959/2001, p. 194).

Klafki's perspective is that educational topics of relevance to the students' present and future lives prepare them for participation in society and in its development. These are topics that enhance autonomy in terms of self-determination, co-determination and solidarity. Furthermore, these are topics that enhance *Bildung* for all with the starting point in their horizons of understanding, topics with core contents on key contemporary problems such as sustainability and social justice, and topics that develop broad interests and skills (Hohr, 2011, pp. 167–169; Klafki, 1985/2001, p. 176).

Exemplification of subjective and objective terms

Educational topics must be exemplified by educational materials where the topic is visible in the situation, incident or item. The exemplary value of the material comprises both the subjective and the objective aspects and must therefore be both elementary to open the students' understanding and fundamental to open the general idea of the topic (Klafki, 1959/2001). The thought of the exemplary is rooted in Aristotle's thought of general ideas as present and possible to experience in the perceptible, as opposed to the thought of Aristotle's teacher Plato who argued that the perceptible is unreal and a shadow of an underlying general idea (Hohr, 2011, pp. 167–169). Klafki himself questions in his later works whether 'elementary' and 'fundamental' are relevant terms for describing exemplification. Exemplary value comprises scientific knowledge but cannot be derived from science because it also constitutes the subjects' contemporary understandings (Klafki, 1985/2001, pp. 174–175).

Klafki's perspectives on students' development through engagement with educational materials provide us with lenses to examine how the students' perspectives coincide with the essential elements in educational practice on DfS.

Designing for sustainability opens understanding on the influence between products and potential environmental impacts

Klafki's theory of *kategorialen Bildung* provides the essential knowledge for the operationalisation of educational topics in educational practice. This case study uses three fundamental ideas from Klafki's theory as analytical lenses to examine the students' perspectives, as well as the objects and the exemplification of these in the DfS process. First, the experience of understanding

(described by Klafki as *kategorialen Bildung*) evolves in the encounter between a subject and an object, a human and the culturally represented world, and in school between a student and the educational material that exemplifies the educational topic. Second, the students' development of understanding starts in their points of view on the purpose of the educational topic in their past, present and future lives. From these perspectives, the teacher must prepare for a broadening of their horizons and enhance autonomy in terms of self-determination, co-determination and solidarity. The student groups' two perspectives on environmental concerns in product design as an educational topic identified in the interview data are as follows: (a) it is useful for both practical design and handcraft work in school and in everyday consumption; and (b) it is a theoretical topic with key answers, which will disrupt the school subject's purpose of engaging in creative processes and practical design and handcraft work, as well as shift the practice in classes from practical to theoretical work. Third, the development of understanding depends on the exemplification of the topic. The objects of educational materials exemplify the educational topic's DfS when they visualise the general ideas of DfS in the situation, incident or item and, at the same time, comprise the students' subjective conditions of critical thinking, judgement, will and imagination. An analysis of the educational practice in DfS and the students' perspectives through the lenses of Klafki's theory clarifies fundamental issues in the preparation for the development of understanding on DfS among students.

Clarifying educational practice in designing for sustainability

The overall purpose of DfS equals the purpose of education for sustainable development – to develop sustainable societies in sustainable environments. The DfS topic engages in practical approaches for this development. It comprises the bidirectional influence between products and environments, where both affect each other. Products influence ecological, social and economic environments. They draw from natural resources, alter landscapes, reduce biodiversity, pollute the environment and generate waste during their entire lifecycle, from material excavation, development, use and disposal to material reuse. Environments also influence the design of products. Environments provide natural resources for materials and energy for the production and use of products and set limits for resource extraction. With the appreciation of low negative impacts and high positive impacts on environments presented in current design theories (Cooper, 2005; McDonough & Braungart, 2009, 2013; Stegall, 2006), it is fair to say that environmental concerns have become quality criteria for product design. With the purpose and general idea of DfS in place, an analysis of this topic through the lenses of Klafki's theory will locate the objects in an educational situation in DfS.

As the educational topic comprises DfS, two subtopics need exemplifying in the objects of educational materials: one involves design products and the

other relates to potential environmental impacts from products. The different characteristics of these objects set the premises for the students' methods of engaging with them. Design products can be exemplified with a *design product (present object)* that is present in the school studio and experienced through practice in the design and handcrafting process, with the potential of opening the understanding about the product's qualities. The potential *environmental impacts (absent object)* of this product are absent from the school studio and must be exemplified with information and knowledge and be experienced through reflection, with the potential of opening the understanding about environmental impacts. Experience of the design product and reflection on the information on the knowledge about potential environmental impacts engage the students in the DfS process. In DfS, their reflections on the bidirectional influence between the product and the environment are used in the process of designing and handcrafting the product. This process exemplifies the DfS topic and is therefore also an object in the educational practice in DfS. Klafki defines the situations, incidents and items that exemplify the educational topics as objects (Figure 12.1).

Students' standpoints for development of understanding

This model clarifies educational practice in designing for sustainability. Additionally it can help us clarify the differences between the students' perspectives on the educational topic of environmental concerns in product design.

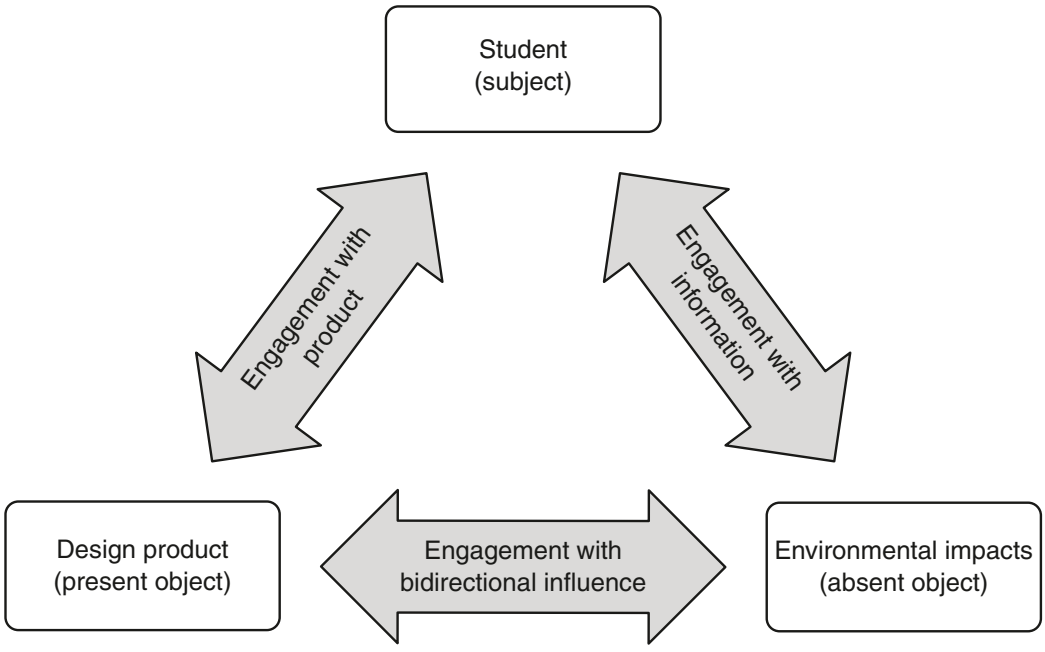

Figure 12.1 Educational practice in designing for sustainability. The model is based on Wolfgang Klafki's (1959/2001) theory of *kategorialen Bildung*.

The first perspective is of the topic as useful for practical design and handcraft work in school and in everyday living. This refers to engagement with the bidirectional influence between the design product and the potential environmental impacts in design projects. The second perspective is that the topic is theoretical and holds key answers, which will disrupt the school subject's purpose of engaging in creative processes and practical design and handcraft work, as well as shift the practice in classes from practical to theoretical work. This perspective mainly refers to the engagement with the information on potential environmental impacts as an additional topic to the engagement with the product and the design process. Environmental concerns become a topic to learn about rather than to use in the design process. This causes worries, which the students who relate environmental concerns to the design process do not express. However, the students agree that the main purpose of the education is to engage in the design process of making a product. To follow Klafki's (1959/2001; 1985/2001) idea, it is from this point of view that the students' development of understanding starts and from this standpoint that the teacher must prepare for broadening their horizons towards a holistic understanding of DfS.

Development of understanding through examples

The standpoint for the students' development of understanding is the design process and it is here the topic of DfS must be exemplified. According to the theory of Klafki, the exemplification both represents the general idea of the topic and opens the students' understanding (1959/2001; 1985/2001, pp. 15–20). This comprises in the topic of DfS exemplification of the design product, the potential environmental impacts and the bidirectional influence between the two in the design process.

In the design product (present object) that is present in the school studio, the product's qualities that cause the environmental impacts can be exemplified, perceived, experienced and altered as they are developed during the design and handcrafting process. These are qualities with direct environmental impacts, such as the selection of materials from renewable resources and design for material recycling when the product is no longer used (McDonough & Braungart, 2009, 2013). Additionally, these are qualities that reduce consumption through an increase in the products' life spans. Examples of these qualities are high quality materials, quality handcrafting and durable, maintainable and mendable constructions (Cooper, 2005, p. 61). These can also be characteristics that enhance emotional product attachment, such as scarce products and products intended as gifts (Gulden et al., 2010). The possibility of experiencing the qualities and their relation to oneself in the school studio makes them perceptible examples of product qualities. However, the environmental impacts that the product and its use impose cannot be perceived or exemplified in the product.

The information about potential environmental impacts (absent object) is absent from the school studio. This includes limits on how much resource

excavation, material production, emissions and waste are tolerated by nature, limits on human exposure to toxic substances, and lower limits on production costs without dropping to poverty-level wages for production workers and without exploiting nature. It also consists of positive impacts such as fertile soil from the compost of biodegradable products (McDonough & Braungart, 2009, 2013). A common characteristic of these aspects is that they are not present in space and time to be perceived and experienced in the school studio while designing a product. They accumulate over time, when the resources are extracted, the emissions occur, the waste is disposed, and the production workers are exploited. Precautionary details on how to avoid causing environmental damage can be found in product information. Additionally, examples of long-term consequences of violations of environmental limits are accessible through sources such as the Internet. These examples are essential to understanding the general issue in DfS.

It is primarily in the DfS process that the knowledge about products' potential environmental impacts relates to objects of perception in space and time in the school studio. Here, the potential environmental impacts can be reflected on, as well as altered and become practical implementations of importance to sustainability in the students' products. The knowledge informs students about the strategies to design for sustainability. Examples on these are the negotiations between designing for resource-efficient or durable products (Cooper, 2005). It offers knowledge about the engagement with design and handcraft for increased product life spans (Cooper, 2005). It explains about designing for emotional product attachment (Gulden et al., 2010). It teaches students about safety in products and production (McDonough & Braungart, 2009, 2013) with the use of protective equipment in material handling, according to health, environment and safety information (HES).

The design process of creative problem solving and the performance of handcraft engage the students' subjective conditions, critical thinking, judgement, will and imagination with scientific knowledge on the topic. The examples of the product and the potential environmental impacts inform each other by providing design issues that students should be critical and creative about, as well as for the thorough execution of the handcrafting. This meaning reaches beyond the students' relation to the product and beyond the present time of this particular school project. The design process grounds their understanding of the concept of the product qualities' direct or indirect influence on sustainability in practical, empirical experiences with the product they are designing. This grounding of concepts in experiences is in line with the core characteristics of the *Didaktik* tradition (Gudmundsdottir et al., 2000, p. 321). The DfS process has the potential of exemplifying the development towards sustainability as not only understandable, but also relevant because it offers influential engagement. DfS brings purpose to the educational topic of environmental concerns in design.

Understanding design problems and design solutions enhances societal change

Education for sustainable development, high on the international agenda and of relevance to students, comprises the long-term goal of sustainability in ecological, social and economic environments, along with the developmental steps to achieve it. These are vast topics that can seem incomprehensible. Both students and teachers can feel powerless in encountering issues that need new solutions in the near future. Exemplification in practical design and handcraft work breaks down the topics into manageable sizes and brings these into the classroom as perceptible in practical work. Nonetheless, DfS's immanent idea that design is part of both the problem and the solution to environmental unsustainability is challenging. Whether the examples should represent design problems, design solutions or both is a relevant question. The selection of examples can be challenging in the education of young people. Nonetheless, Klafki reminds us that the purpose of education is to empower students for democratic participation in societal development with autonomy in and through self-determination, co-determination and solidarity (Klafki, 1985/2001, p. 176).

Exemplifying environmental concerns in design education might seem as risky as opening Pandora's box: once the reflections have begun, it generates many complicated problems. First, it opens up a massive critique of our present educational practice, as well as of our everyday living. Most of today's products, both commercial and those we design and make in school, raise some sort of environmental concern. Second, revealing these concerns about design makes the products we design, as well as consume, examples of unsustainable design practices rather than the sustainable solutions we aim to achieve. Third, these examples of unsustainable products can bring up questions of how to solve problems to which the teacher does not have answers, either because the teacher's knowledge on the issue is limited or the solutions are yet to be found. To reduce the issues with teachers avoiding unsolved problems, decreasing the students' dependence on teachers has been suggested in professional design education (Clune, 2010).

Exemplifying sustainable solutions demonstrates what we aim to achieve and possible paths to reach our goal, but it brings up other issues. First, it excludes most of our everyday products, as well as the products we design in school, and exemplifies DfS as a niche for a handful of products. Second, broadening the scope by including products with fairly good solutions could be done by focusing on sustainable details while disregarding unsustainable ones although this would provide misleading information on environmental concerns, in terms of "greenwashing". Greenwashing educational practice is incompatible with the idea of education for sustainable development. Rather, the role of formal education is to empower students to recognise when greenwashing occurs in the formal, unformal or non-formal education. Sustainable development requires information and honesty about what the problems are and what direction development should be heading in.

Exemplification of problems without solutions has the potential of generating despair. Will it leave the students only with the hope that the solutions will emerge sometime in the near future? However, solutions are not things that emerge or develop by themselves; neither do sustainable societies develop by themselves in the future. Teenagers are already participating in societal development and will continue to do so during their entire lives. They consume products and engage in democratic processes and will soon vote in elections and join the work force as employees and entrepreneurs. Education's goal is that they participate in societal development in a sustainable direction to secure fruitful lives for themselves, their children and the generations to come. Education's responsibility is to empower young people to do so. Reflection on what needs to be changed is fundamental to the idea of development, whether it involves unsustainable products or the unsustainable practices that we engage in when using these products. The idea of development is the idea of design (Clune, 2010). The variety of design strategies in DfS helps us clarify what to expect from design and therefore also what is exemplified in educational practice. Design education for sustainability clarifies challenges and solutions towards sustainable development and makes it relevant for the young.

Designing for sustainability – a holistic approach

The starting point for this study has been the set of initiatives for the development of sustainable societies through design education. Against the background of Klafki's fundamental idea that students' development of understanding starts from their points of view, two groups of students were asked about their opinions on the new educational topic. An analysis was laid out on the central element of Klafki's theory of *kategorialen Bildung* and the theory of DfS. This indicates that the students who consider environmental concerns as an additional topic to learn about rather than to use in the design process express a negative attitude towards the topic, which the students who relate environmental concerns to the design process do not express. Furthermore, the study has discussed how environmental concerns have the potential of being resources rather than obstacles in creative and practical work, as long as they exemplify how potential environmental impacts and design products influence each other and can be altered. The students favouring creative and practical work form the heart of DfS; it is a most beneficial starting point for broadening their horizons on the relevant role that their interest in practical and creative work plays in the development of sustainable societies. Such a role includes the ability to develop solutions that involve environmental awareness. This brings up the complexity of environmental concerns and design solutions as educational topics at the lower secondary level.

References

Boehnert, J. (2013). Ecological literacy in design education: A foundation for sustainable design. In J. B. Reitan, P. Lloyd, E. Bohemia, L. M. Nielsen, I. Digranes & E. Lutnæs (eds), *Design learning for tomorrow. Design education from Kindergarten to PhD. Proceedings from the 2nd International Conference for Design Education researchers, 14–17 May 2013, Oslo, Norway* (Vol. 1, pp. 442–457). Oslo: ABM-media.

Boehnert, J. (2015). Ecological literacy in design education: A theoretical introduction. *FORMakademisk*, *8*(1), 1–11. doi: http://dx.doi.org/10.7577/formakademisk.1405

Ceschina, F. & Gaziulusoy, I. (2016). Design for sustainability: An evolutionary review. Paper presented at the Design Research Society's 50th Anniversary Conference, Brighton, UK. Retrieved from www.drs2016.org/059/

Clune, S. (2010). Deep learning and industrial design education for sustainability. Paper presented at Connected 2010–2nd International Conference on Design Education, University of New South Wales, Sydney, Australia.

Cooper, T. (2005). Slower consumption: Reflections on product life spans and the "throwaway society". *Journal of Industrial Ecology*, *9*(1–2), 51–67.

European Design Leadership Board (2012). *Design for growth & prosperity*. Retrieved from http://europeandesigninnovation.eu/wp-content/uploads/2012/09/Design_for_Growth_and_Prosperity_.pdf

Fontana, A. & Frey, J. H. (2008). The interview: From neutral stance to political involvement. In N. K. Denzin & Y. S. Lincoln (eds), *Collecting and interpreting qualitative materials* (pp. 115–159). London: Sage.

Goodlad, J. I., Klein, M. F. & Tye, K. A. (1979). The domains of curriculum and their study. In J. I. Goodlad (ed.), *Curriculum inquiry: The study of curriculum practice* (pp. 43–76). New York: McGraw-Hill Book Company.

Gudmundsdottir, S., Reinertsen, A. & Nordtømme, N. P. (2000). Klafki's Didaktik analysis as a conceptual framework for research on teaching. In I. Westbury, S. Hopmann & K. Riquarts (eds), *Teaching as a reflective practice. The German Didaktik tradition* (pp. 319–334). London: Routledge.

Gulden, T., Moestue, C. & Berg, A. (2010). Psychology-based design approach (PSYDA): A pedagogical concept. Paper presented at the International Conference on Engineering and Product Design Education, Norwegian University of Science and Technology, Trondheim, Norway. Retrieved from www.academia.edu/990718/Psychology_Based_Design_Approach_PSYDA_-A_Pedagogical_Concept

Hohr, H. (2011). Kategorial danning og kritisk-konstruktiv didaktikk – den didaktiske tilnærmingen hos Wolfgang Klafki [Kategorialen Bildung and critical-constructive Didaktik – The Didaktik approach of Wolfgang Klafki]. In K. Steinsholt & S. Dobson (eds), *Dannelse: Introduksjon til et ullent pedagogisk landskap [Bildung: Introduction to a unclear pedagogical landscape]*. Trondheim: Tapir Akademisk Forlag.

Hopmann, S. & Riquarts, K. (2000). Starting a dialogue: A beginning conversation between Didaktik and the curriculum traditions. In I. Westbury, S. Hopmann & K. Riquarts (eds), *Teaching as a reflective practice: The German Didaktik tradition* (pp. 3–11). New Jersey: Lawrence Erlbaum Associates Inc.

Klafki, W. (1959/2001). Kategorial dannelse: Bidrag til en dannelsesteoretisk fortolkning av moderne didaktikk [Kategorialen Bildung: A contribution to a Bildung

theoretical interpretation of modern Didaktik] (A. Gylland, Trans.). In E. L. Dale (ed.), *Om utdanning [About education]* (pp. 167–203) (1st edn). Oslo: Gyldendal.

Klafki, W. (1985/2001). *Didaktikk og dannelsesteori – Nye studier* [*Didaktik and Bildung theory – new studies*] (B. Christensen, Trans.). Århus: Forlaget Klim.

Kouppanou, A. (2016). Imagining imagination and Bildung in the age of the digitized world picture. In A. Fulford & N. Hodgson (eds), *Philosophy and theory in educational research: Writing in the margin* (pp. 121–128). Oxford: Routledge.

McDonough, W. & Braungart, M. (2009). *Cradle to cradle: Remaking the way we make things*. London: Vintage Books.

McDonough, W. & Braungart, M. (2013). *The upcycle: Beyond sustainability – designing for abundance*. New York: Melcher Media.

Ministry of Education and Research. (2006). *Arts and crafts subject curriculum*. Retrieved from www.udir.no/upload/larerplaner/Fastsatte_lareplaner_for_Kunnskapsloeftet/english/Arts_and_crafts_subject_curriculum.rtf.

Nielsen, L. M. (2009). *Fagdidaktikk for kunst og håndverk: i går, i dag, i morgen* [*Art and crafts education: yesterday, today, tomorrow*]. Oslo: Universitetsforlaget.

Royal Ministry of Education, Research and Church Affairs. (1997). *Core curriculum for primary, secondary and adult education in Norway*. Oslo: Royal Ministry of Education, Research and Church Affairs.

Royal Ministry of Education, Research and Church Affairs. (1999). *The Curriculum for the 10-year compulsory school in Norway Oslo: National Centre for Educational Resources*. Retrieved from http://urn.nb.no/URN:NBN:no-nb_digibok_2010032503005.

Stegall, N. (2006). Designing for Sustainability: A Philosophy or Ecologically Intentional Design *Design Issues*, *22*(2), 56–63.

United Nations Educational, Scientific and Cultural Organization. (2014). Shaping the future we want: UN Decade of Education for Sustainable Development (2005–2014). (Final report). Retrieved from http://unesdoc.unesco.org/images/0023/002301/230171e.pdf

World Commission on Environment and Development. (1987). *Our common future*. Retrieved from www.un-documents.net/ocf-02.htm

Article 2

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Ingvill Gjerdrum Maus

Developing design literacy for sustainability

Lower secondary students' life cycle thinking on their craft-based design products

Abstract

This article discusses the case study Case Keramikk, examining students' use of experiential learning from a craft-based design practice in life cycle thinking on their products. Data were constructed through semi-structured group interviews with students of a Norwegian lower secondary school and thematic analysis based on the principles and practices of design for sustainability (DfS). The interview questions engaged the students to assess their practice and products and to estimate environmental considerations. The students used experiential learning that correspond with the DfS practices of eco-efficiency, eco-effectiveness and product durability in the production phase, as well as the distinctive characteristics of materials, products and production decisive for practice of these in the material extraction and use and disposal phases. These reflections enhance students' development of design literacy for sustainability and strengthen their democratic participation in research for development of education in craft-based design for sustainability.

***Keywords*:** Design literacy for sustainability, design for sustainability (DfS), crafts-based DfS, lower secondary education

Inquiry in life cycle thinking within youths' craft-based design education

This article discusses the case study Case Keramikk, on students' use of experiences from craft-based design practice in their reflections on environmental considerations throughout their products' life cycle. The case study draws upon research concerning students' development of design literacy, which is a competence to understand and create design in physical materials in the context of what supports sustainable environments (Nielsen & Brænne, 2013). Furthermore, it draws on research that interprets and discusses the possibility for youths to develop qualifications for democratic participation in sustainable development and consumption through experience and reflection in design and crafts practice (Digranes & Fauske, 2010; Illeris, 2012; Lutnæs, 2015a, 2015b, 2017, 2018, In press; Lutnæs & Fallingen, 2017; Nielsen, 2009; Nielsen & Digranes, 2007, 2012). However, there is a need for empirical studies on students' experiential learning (Nielsen & Digranes, 2012).

I present an extensive data analysis of the experiences from creation of a craft-based design product that students use when asked to reflect on their practices, their products' quality and environmental considerations. Also, I address the kinds of environmentally considerate design practices, or design for sustainability (DfS) practices in product innovation (Ceschin & Gaziulusoy, 2016), that correspond with the students' experiences and therefore may be exemplified in their work. The concept of life cycle thinking (LCT; Heiskanen, 2002) is used to understand reflections on products' life cycles, from material extraction to product disposal. The results of my analysis raise epistemological questions concerning the potential for and relevance of students' development of design literacy for sustainability through embedding of LCT and DfS practices in their craft-based design practices. I discuss these questions in the context of knowledge theory by Klafki (1959/2001, 1985/2001).

Case Keramikk, semi-structured group interviews and thematic analysis

The case study, Case Keramikk, included seven 15–16-year-old students, two males (called Tom and Jon in this paper for anonymity) and five females (called Mia, Ann, Eva, Ada and Ane) who accepted my interview invitation. They were attending 10th grade, the last year of their compulsory education, at a Norwegian lower secondary school in the spring of 2015, and they had been tasked with a craft-based design project using clay in the school subject Art and Crafts. The research was performed with the consent of the students and their parents and the approval of Norwegian Centre for Research Data (NSD).

This case was theoretically sampled based on Nielsen and Brænne's (2013) description of the development of design literacy, for the clay projects' involvement of thorough, time-consuming craft-based design practices. The course was led by a teacher with subject specialisation in Art and Crafts and was held at a studio at the school. The students worked on the project over 18 three-hour lessons (altogether, 54 hours of the total of 146 hours Art and Crafts classes at the lower secondary level). Students were tasked with designing and crafting a utility object or sculpture and making a PowerPoint presentation of the process and product. The learning objectives included sketching designs and decoration and high-quality crafting of a utility object or sketching and interpreting the human figure in a sculpture. Five students (Mia, Ann, Tom, Eva and Ane) made vessels (approximate height 20–40 cm) with glazed decoration, while two (Ada and Jon) made sculptures of a human figure. The environmental context of their craft-based design products was not discussed during the project.

Semi-structured group interviews (Fontana & Frey, 2008; Kvale & Brinkmann, 2015) were conducted in two groups: interview group 1 (IG1), which comprised two students, and interview group 2 (IG2), which comprised five students. The interviews were held at the school, with the ceramic products present, and were documented with video recordings totalling 58 minutes for IG1 and 70 minutes for IG2. The interview questions, which included prepared questions with open-ended answers as well as improvised questions for elaboration or confirmation, asked about the environmental considerations in their ceramic products' design, production and use of materials. The questions were based on the DfS principles of LCT concerning raw material extraction, manufacturing, distribution, use and disposal (Cooper, 2005; Heiskanen, 2002) and triple bottom line (TBL) concerning aims of environmental sustainability with environmental quality, social equality and economic prosperity (Elkington, 1999). Moreover, DfS practices for eco-efficiency with low use of resources cradle-to-grave (Cooper, 2005, 2010), eco-effectiveness with circular use of resources cradle-to-cradle (McDonough and Braungart, 2009, 2013) and product durability and longevity (Chapman, 2009, 2010, 2015; Cooper, 2005, 2010; Stahel, 2010). The questions encouraged students to provide descriptions in their own terms rather than the technical vocabulary used in the selected theories.

A thematic analysis (King & Horrocks, 2010, pp. 142-174) of the interview video recordings was conducted in three stages with several steps. The first stage was *descriptive coding*. This involved familiarisation, transcription, tidying up of overlapping responses, anonymization of individuals with codes and organisation of the transcriptions in coded analytical units based on the introductory interview questions. The second stage was *interpretive coding*. Units were categorised into 3 themes based on the product life cycle phases of material extraction, production and use and disposal and 11 sub-themes regarding materials, products and production that correspond with DfS practices. The third step was *definition of overarching themes*. These themes were three DfS practices—eco-efficiency, eco-effectiveness and product durability—which relate to the experiential learning about materials, products and production mentioned by the students in their reflections on the life cycle phases (Figure 1).

DfS practices in the students' life cycle thinking about their craft-based design products

In collaboration with each other, the students used their experiences from the craft-based design practice in clay in reflections on the environmental context of their products' life cycle phases.

These include 1) material extraction, 2) production and 3) use and disposal. The thematic analysis shows that the students used experiential learning from the school studio that correspond with, and has potential as examples for engagement with:

a) *DfS practices in the production phase.* These practices include eco-efficiency with low use of resources; eco-effectiveness with circular, safe use of resources; and design for the durability of emotionally valuable personal belongings.
b) *Distinctive characteristics of materials, products and production decisive for DfS practices in the phases of material extraction and use and disposal.* These include eco-efficiency with low use of resources, eco-effectiveness with safe, circular use of resources and design for product durability through functional, emotional, aesthetic and intrinsic product qualities in decorative artefacts, personal belongings and gifts.

The data analysis reveals students' use of experiences and knowledge acquired during the production phase in their reflections on life cycle phases before and after the craft-based design practice. The extensive data document the students' subjective and contextual understandings of the craft-based design products they made at school. These are used to analyse the products' correspondence with—and relevance as examples of—different DfS practices and distinctive characteristics that determine whether or not DfS practices can be carried out. Figure 1 visualises the results in a model of LCT in craft-based design.

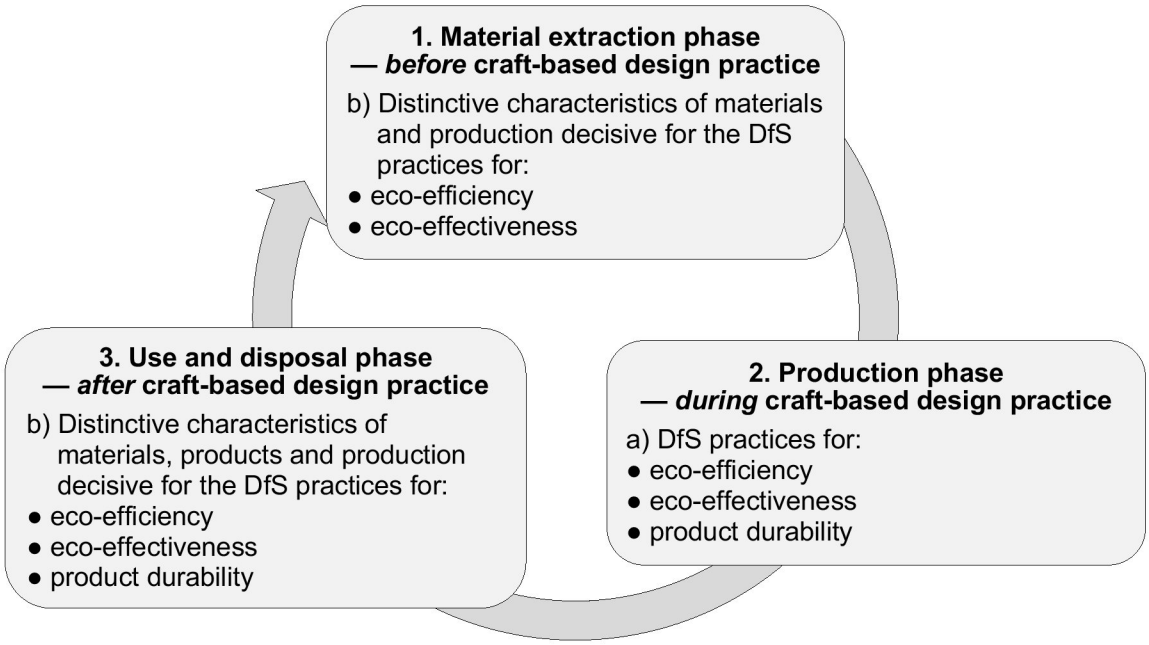

Figure 1. The model of LCT in craft-based design, containing the three life cycle phases of the students' craft-based design products and their experienced a) DfS practices and b) the distinctive characteristics of materials, products and production decisive for these practices.

In the interviews, the students described how they designed and crafted their products. They found inspiration in books (Tom, Eva, Jon) and on the Internet (Ann, Ane), and then they sketched the product they wanted to make. The five students who made vessels (Mia, Ann, Tom, Eva, Ane) also made a cardboard template of the intended profile to ensure accuracy and used a coiling technique and simple hand tools to make the vessels. Between classes, all the students wrapped their products to prevent them from drying (Ada, Jon, Ane). Finally, after

firing, they created a mask with tape to guide application of glaze for decoration (Ane). The students agreed that the teacher's thorough guidance regarding the design and making processes was crucial for them to successfully make their products (Ann, Tom, Eva, Ada, Jon, Ane). One of the students said, "I learned how to do it. It would not have been possible without the teacher, because I would not have understood how to construct it by myself" (Ann).

Material extraction phase* — before *the craft-based design practice

The first phase (Figure 1) in the products' life cycle includes extraction and production of raw materials. This phase took place prior to the production phase of designing and making in the studio, and therefore was not experienced by the students.

Ecological resources for material extraction

Environmentally considerate practices of material extraction ensure that ecological resources are not depleted. The interview questions related to this topic asked the students about their knowledge of the clay's content, origin and renewal process as well as the environmental impact of extracting clay. In their reflections on the consequences of clay extraction, the students drew upon their knowledge about clay's distinctive characteristics and origin. In addition, they mentioned humans' use of clay throughout history. DfS theory emphasises eco-effectiveness that support circular use of resources including natural renewal processes (McDonough & Braungart, 2009, pp. 68-91). The students' reflections reveal how they estimated on whether clay is a renewable resource, or a non-renewable resource where the extraction for ceramic production exceed nature's development of new clay.

The students said that they had talked about the content of clay (Mia), but not read about it (Tom, Eva, Ada, Jon). They described clay as consisting of sand, gravel and water (Jon) or rock and soil (Mia). They believed that it was a naturally renewable resource but did not know how long the renewal process takes (Tom, Eva, Jon). One student thought that the renewal process of clay takes a long time (Ane), and two others stated that clay renews too slowly to keep up with demand and therefore will be depleted (Mia, Ann). One believed that it is likely there are negative consequences of excavating clay, as everything has negative consequences (Ada). In contrast, another student believed that it is unlikely that clay extraction has negative consequences, as humans have used clay since the Stone Age and thus the effects of clay extraction should have been observed by now (Jon).

Human resources in the process of material extraction

Environmentally considerate practices of material extraction must consider the human resources involved in this process; extraction workers must have social equality with living wages and acceptable working conditions. The interview questions concerned whether the clay had been extracted in Norway or another part of the world as well as what the students thought about the work conditions and wages for clay extraction workers and the price of clay. The students drew upon their experiences and knowledge of the clay's distinctive characteristics of weight, consistency and origin. DfS theory emphasises eco-efficiency, defined as productive use and reduced loss of material resources (i.e. raw material and energy; Cooper, 2005). The students referred to similar ideas regarding efficiency of the use of human resources when they estimated the working conditions and possibilities of using machines for material extraction to reduce the burden of extraction workers.

None of the students knew which part of the world the clay had come from, but one suggested that it is likely the package for the clay contains information about this (Jon). The students reasoned that extraction workers have a burdensome (Ann, Ada) and dirty job (Ada) but receive low wages (Mia, Ann, Ada). One stated that the use of machines probably makes extraction less burdensome for the workers (Mia). The students believed clay to be a cheap material (Mia, Ann, Ada), and that it was used in the class because they assumed the school's

financial status was poor (Jon, Ane). Another student reasoned that different types of clay could have different prices (Eva).

Production phase* — during *the craft-based design practice

The production phase (Figure 1) in the products' life cycle involves safe and efficient use of material and human resources. The students experienced this phase while participating in the craft-based design practice at the school's studio.

Effective use of material resources

Environmentally considerate production practices ensure that material resources are not wasted. The interview questions concerned the students' experiences with the remains and squandering of materials as well as their opinions on relevant approaches for learning environmentally considerate practices as part of this project. The students used their experiences with efficient use of clay, effective recycling with reclaiming of dry clay shreds and inefficient use of clay in the crafting process. DfS theory emphasises eco-efficiency in terms of productive use and reduced loss of material resources during production (Cooper, 2005) and eco-effectiveness in terms of recycling disposed material resources (McDonough & Braungart, 2009, pp. 92-117). Among the students, squandering and ways to reduce it were topics of discussion. They highlighted the potential of learning for efficient use of resources and waste reduction during the production process.

The students explained that, while crafting their ceramic products, some clay was wasted because students threw clay around inside the studio (Mia), they took more clay out of the package than they needed (Ada) or they did not properly close the clay package, causing that the clay dried up and became unusable (Ann, Ada). The students confirmed that they tried to more completely close the package after experiencing that the clay became dry and hard (Ada, Jon). They had also learned how one can mix dry clay with water into a slip and use it to join different parts (Eva, Jon, Ane). One of the students said that they could have taken better care of the materials (Mia). Others suggested that reduction of squandering is one way to learn environmentally considerate practices (Ada), another is firing of clay (Mia), which is energy-consuming. Although one of the students said that the class had not talked much about the squandering of materials (Mia), believed another that the teacher wanted them to take care of the materials (Ann), while a third did not have the same impression of the teacher's opinion on the squandering because he had worked with a type of clay that neither the he nor the teacher considered suitable (Jon). The need to avoid squandering was explained by one as follows: "It wastes everything. It wastes money and material. There is no point in having something and just throwing it away" (Ann). However, reducing squandering is a difficult goal to achieve, admitted another: "I am interested, but it is not certain that one is engaged enough to actually do much, even though one thinks it is stupid how things are. It is stupid that we throw away so much, but one still throws away things" (Eva).

Health, environmental and security precautions

Environmentally considerate practices in production process must take health, environment and security (HES) precautions into account. The interview questions concerned the students' knowledge about the potential toxicity of the materials and their use of protection against the materials. The students explained their experiences with HES precautions during glazing. The DfS practices of eco-efficiency and eco-effectiveness emphasise reduction and substitution of materials that cause hazardous emissions and the need to design for and use materials that will be safe throughout the product's life cycle (Cooper, 2005; McDonough & Braungart, 2009, pp. 53-63). The students shared this emphasis, mentioning that they are aware of the need to use protective equipment to safely applied glaze. However, they experienced some inconveniences when using the equipment.

After modelling and firing their products, the students applied glaze, which was toxic during application (Ann, Eva, Ada, Jon, Ane). One student noted that it was important to avoid inhaling dust from the glaze while scraping the edges of the decoration (Ann). They wore gloves and particle masks for protection while working with certain types of glaze (Ann, Ada), but one student said that it was uncomfortable to wear the elastic band around her head and it was better to hold the mask in front of her mouth and nose, which was unpractical when both hands were needed to decorate the work (Ann).

Production and product value

Environmentally considerate production practice that offer social equality through living wages, depend upon the products' economic value. The interview questions regarding this issue concerned students' thoughts about a suitable price for their products and how this price relates to their production work, potential wages and material costs. The students drew upon their experiences with using their own human resources in the production process as well as their products' contextual meaning and value. DfS theory emphasises that objects with context-specific meaning and personal belongings are valued as emotionally durable objects that carry narratives and manifest memories (Chapman, 2010, p. 70, 2015, pp. 42-47). Estimating the relation between their products' potential prices and their work provided students an opportunity to reflect on potential wages. They considered their products to be of little economic value and not comparable to either manufactured retail products or professionally handmade products. Rather, the products are personal belongings with emotional value, as they narrate and manifest their experiences with the production process in the school context.

The students suggested that suitable prices for their products would be nothing (Jon), 50 Norwegian kroner (USD 6; Ann, Ane) or 100 kroner (USD 12; Mia, Ann). When asked how this price relates to their work in the production process, they estimated that they spent approximately 60 hours on the project (Eva, Jon, Ane; a more accurate estimate would be 54 hours, as they forgot to eliminate time for public holidays). The students said the clay work was time-consuming (Mia, Ann), with two describing it as more time-consuming and monotonous than they expected (Eva, Ane). They agreed that the prices they suggested were not likely to even cover the material expenses, so the hourly wage would be almost nothing (Mia, Ann, Jon). One student acknowledged that products made from large amounts of clay are worth more than smaller products (Ada). However, their experiences with their products related to their beliefs about the products' quality, contextual meaning and value, and they believed that products made in a school context are worth less money than other objects (Ann). One student said, "I do not believe that any of us are at a level where we can start to sell vessels" (Ane). One of the students who suggested that her vessel was worth 100 Norwegian kroner (USD 12) suggested that a similar vessel would cost 300 Norwegian kroner (USD 35) in a shop if it was professionally made (Mia). Three said that the price of a product depends on its maker, with products made by famous artists costing the most (Ann, Eva, Jon). Another student said that handmade products are unique and therefore cost more than manufactured products, which are only one of many (Mia). Two agreed that a product made by an artist can cost about 2000 Norwegian kroner (USD 234) (Ada, Jon), while a similar product from a factory could cost about 100 Norwegian kroner (USD 12) (Jon). They argued that some stores maintain low retail prices (Tom) by producing their products in countries that offer workers low wages (Jon).

Use and disposal phase* — after *the craft-based design practice

The last phase (Figure 1) of products' life cycle is use and disposal. This is the phase for which the students had designed and crafted their products. It occurs subsequently to the production phase they had experienced in the school studio. In the user phase, an environmentally considerate design ensures that the product can be safely used over a long period of time to reduce the indirect environmental impact of rapid product replacement. The students confirmed that they were aware of the environmental benefits of long-term use of utility objects in general

(Mia, Ann, Eva, Ada, Jon, Ane), and they assessed the durability of their own craft-based design products. However, as we will see in this section, a focus on the use-related qualities of products reduces one's attention on the environmental benefits these products qualities represent.

Functional qualities and products' purpose

Environmentally considerate design practices aim to create products that avoid disposal and replacement, which have a negative impact on the environment. The interview questions concerned the intended purpose of and potential improvements to the functionality of the students' products and the need for a certain number of products. Although creation of a utility object was a learning objective of the school task for the five who made vessels, the students viewed their products as decorative artefacts. This made their products less relevant as examples of functionality, which according to DfS theories concern design for physical functionality that meet needs and increase products' longevity (Cooper, 2005, p. 61; Stahel, 2010, pp. 162-163). However, the meaning of a product is partly determined by individuals and cannot be fully designed for (Chapman, 2015, pp. 42-47). Similarly, in this school task, the students imposed their own meanings and purpose onto the products they made.

The students described their products as primarily decorative artefacts with little utility function. Five made vessels (Mia, Ann, Tom, Eva and Ane), while two made sculptures (Ada and Jon). Two students said that their vessels were decorative artefacts but could also be used as flower vases (Mia, Eva). Only one described his vessel as a utility object intended to be used as a vase (Tom). Some of the students considered their ceramic products to be too large (Mia, Ann), heavy (Ann) and dominating (Eva, Ada) and therefore not easy to place, so they only need a few (Ann). Smaller glass vases (Ada) and flower pots (Ane) can be used for different purposes and occasions (Jon), and thus the students' families keep several (Ada). One student said that her vessel would have been more practical if it was smaller, but she liked it as it was (Mia).

Product emissions during use

Environmentally considerate product design practices ensure that products can be used and safely maintained without causing direct environmental impacts from hazardous emissions. The interview questions concerned the students' thoughts on maintenance of their products and the toxicity of glaze. The students drew upon their experiences with their products and the teacher's introduction of safety precautions. According to DfS theory, products must not expose humans and environments to toxins and other hazardous substances, and there is a need to regulate and phase out use of unsafe substances (McDonough & Braungart, 2009, pp. 53-63). The students' reasoned that some types of toxic glaze become safe through firing or combination with other substances, and that their teacher select materials for safe products.

The students believed that maintenance of their ceramic products merely involved dusting (Mia, Ann). They did not know whether their products could emit toxic substances, as the glaze had been toxic before firing. However, one stated that the products must be safe in use and he trusted the teacher to choose safe glaze for their project (Jon). Others suggested that ceramic products intended for food preparation have a protective coating (Mia) or undergo sterilisation before use (Ann).

Emotional qualities of personal belongings and gifts

Environmentally considerate designs include qualities that motivate users to develop an emotional attachment to a product, increasing its durability. According to DfS theory, product attachment is a commonplace phenomenon (Chapman, 2010, p. 70) that can occur when an object carries narratives and manifests memories, which are often connected to when, how and from whom the object was acquired (Chapman, 2009, p. 33). Such products can be described as living objects (Chapman 2015, pp. 42-47). The interview questions asked students about the intended owner of their products and their experiences with keeping their self-made products.

The students considered their products as personal belongings and gifts that actuate emotional attachment though memories and narratives, describing experiences with how their effort and achievement enhanced product attachment and durability, both for the products they kept and those they gave to their parents.

Two of the students intended to keep their products, explaining that they developed an attachment to it during the production process (Mia, Ann). One elaborated that the time spent making a product enhances this attachment and its durability: "I keep those things I have spent a long time making. Small things and things that takes a short time to make are quickly lost — especially those that take a short time to make because then I am not so careful about what I do with them" (Ann). Five of the students intended to give their products as gifts to their parents (Tom, Eva, Ada, Jon, Ane), explaining that their parents highly value and take good care of products made by their children (Tom, Ada, Jon) and, because their child made them (Jon), consider them to be special regardless of what they are (Eva). These students did not consider their parents' tastes during the design process (Ane), even though they were the intended owners of the products.

Outer aesthetic qualities and craftsmanship

Environmentally considerate design practices consider outer aesthetic qualities that encourage product durability. DfS theory emphasises that aesthetic qualities, such as shape and surface, materials that age with dignity, signs of quality and crafted details, enhance a product's longevity (Cooper, 2005, pp. 61-63). The interview questions aimed to determine students' opinions about their products' form and colour and what they would change if they were to make the product again. The students drew upon experiences with their products' aesthetic qualities and revealed that the shape, size and surface with its' colour, decoration and accuracy of glaze work determine their contentment with their decorative artefacts and, thus, their products' durability.

The students who intended to keep their products (Mia, Ann) considered the shape and size to support the products' purpose as decorative artefacts (Mia, Ann), although they were too wide too keep on a shelf (Mia). Overall, they were pleased with the results. One student attempted to give her product an old look by using off-white and brown colours and expected to be content with the decoration for a long time (Ann). She had considered using the colour pink but explained that this was during a 'pink period' and that her preference for this colour was temporary. One student who intended to give their products to their parents explained that she chose a neutral colour (i.e. white) because the product was going to be in her home (Ane), while others stated that they chose colours and decorations that matched the product's shape (Tom) or glaze colours that their teacher had experience with successfully combining (Eva). They were less content with their products' size (Tom), glazing (Eva), shape (Ada, Ane) and decoration (Ane).

Intrinsic product qualities and solid, repairable constructions

Environmentally considerate design practices aim to develop intrinsic product qualities that increase products' durability. DfS theory emphasises that durability depends on intrinsic product qualities, such as resistance to wear; reliability; upgradability; high-quality materials; and robust, carefully assembled and easily repairable constructions (Cooper 2005, pp. 61-63, 2010, p. 8). The interview questions concerned students' thoughts on the solidity and weaknesses of their products' construction, as well as their will and ability to perform repairs if breakage should occur. The students drew upon their experiences with their products' materials and construction to assess their products' robustness, methods of repair and impact of repair on intrinsic and aesthetic qualities. They expressed awareness that their decision to perform repairs is influenced by the products' aesthetic qualities as well as the value their parents and teachers place on repairing the products.

The students judged their own products to be solid (Mia, Ann, Tom, Eva, Ada, Jon), with the slimmest parts being the most fragile (Mia, Ann). They believed that they could repair the ceramic products with glue if they were to break, but these joints would be weak (Ann) and have a different colour than the rest of the product (Mia). One said that her decision to perform repairs in the future would depend on her parents' wishes (Ann), while another stated that he had already performed a repair with the teacher during the project (Jon). Three of the students (Tom, Eva, Ane) were uncertain about whether they would choose to repair their products due to their limited contentment with their products' outer aesthetic qualities.

Safely disposable or recyclable products

Environmentally considerate design practices require safe disposal or recycling of products. DfS theory stresses that that design of products with inseparable materials prevent recycling and cause downcycling of materials towards low or no user quality, moreover prevents storage of safe materials in landfills if these are inseparable from unsafe materials that can leak toxins into the environment (McDonough & Braungart, 2009, pp. 53-63). The interview questions concerned the potential for recycling students' ceramic products. The students were familiar with different disposal practices, and they drew upon the distinctive characteristics of their materials, products and production methods to determine whether it was safe to dispose of or recycle their products. Specifically, based on their experiences with plastic clay and toxic glaze, which became hard and inseparable during firing, they reflected upon whether their products can be recycled to new materials or energy or stored safely.

The students stated that they knew about recycling practices for materials such as glass and metal (Ada, Jon) but had never heard of ceramic recycling (Jon), and none thought it was possible to melt ceramics back into clay and use it to create new ceramic products. One thought it impossible to transform ceramic back into clay because the consistency of the clay became too hard during firing (Mia), while another believed that it is probably not possible to recycle ceramics because it is difficult to separate the clay from the glaze fused onto it at a couple of thousand degrees Celsius (Jon). In response to a question regarding what happens to ceramic products when they are not recycled, one student suggested that they are burned in waste incinerator (Ann), while two believed that they are disposed of in landfills (Mia, Jon). The latter suggestion resulted in mutual reflection by three students on whether it is safe to store glazed ceramics in landfills. The students reasoned that glaze consists of different metals (Eva, Ada, Jon), which are not likely to leak out in a landfill (Jon). None suggested that ceramic pieces could be reused in mosaics or that chamotte from grinding the ceramics could be blended in clay for new products, which are feasible solutions with the technology available today.

Life cycle thinking enhances design literacy for sustainability

In the analysis of the interviews, I find that the students' experiential learning through craft-based design, involved aspects that are relevant as examples of DfS practices. Further, they were able to adequately use their knowledge in reflection on environmentally considerate design solutions and environmental concerns beyond their experiences in the school's studio. This supports Nielsen and Brænne's (2013) argument for the significance of practical design and material experience to the development of design literacy for environmental sustainability. However, it is important to note that the students' environmental reasoning did not emerge out of their practices alone, but in relation to the questions; the stories described in the interviews are created through collaboration between the interviewee and interviewer (Fontana & Frey, 2008, pp. 115-119). In educational contexts, reflections are created by students, their teacher and the questions they ask. Therefore, epistemological issues emerge concerning the questions and the students' engagement with these in the case study, moreover concerning the relevance of embedding questions about products' life cycle in craft-based design education for youth. To discuss these issues, I employ perspectives on the development of knowledge for autonomy in self-determination, co-determination and solidarity taken from the theory of *kategorialen*

Bildung, proposed by the late German pedagogue Wolfgang Klafki (1959/2001, 1985/2001, pp. 101-184).

Engagement in the environmental context

Klafki (1959/2001, 1985/2001) elaborates on the process by which students develop holistic knowledge of educational topics. According to him, this process involves students' engagement with an incident, situation or item that exemplifies the topic. This example must unify the objects that culturally represent the world (e.g. classical culture or scientific knowledge) and the students' subjective critical thinking, judgement, will and imagination. Through this, the students broaden their horizons regarding the relevance of previously acquired knowledge and experiences, developing more holistic knowledge.

Using this description as a framework, I developed a triangular model of the educational practice of DfS (Maus, 2017). The model visualises the student (i.e. subject) and two subtopics: the design product (i.e. present object), which is present in the school's studio, and its environmental impact (i.e. absent object), which is absent in time and space from the studio. The bidirectional arrows visualise the students' method for engagement with these elements. The method for engagement are also educational topics for the students to learn. Below, I present a variation of this model in which the arrows represent craft-based design, LCT, TBL and DfS practice to visualise the students' engagement with the questions in this case study. The bold text indicates the area that was focused upon in this paper (Figure 2).

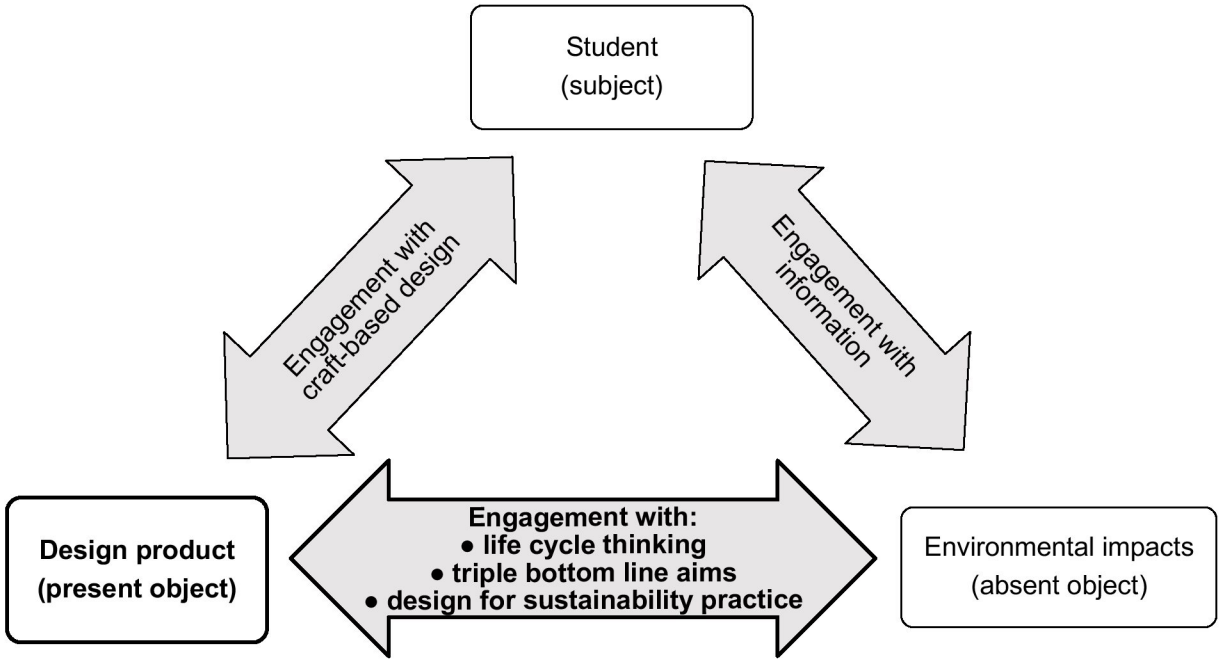

Figure 2. A variation of the model of educational practice in DfS (Maus, 2017). The bold text marks the focus of this study: students' engagement with life cycle thinking (LCT), design for sustainability (DfS) practices and the influence between their craft-based design products and the triple bottom line (TBL) aims of environmental quality, social equality and economic prosperity.

The *examples* in this case study were the items of the students' craft-based design products and the situations of their production phase, which concerned the educational topics of ceramic products and craft-based design. The students had engaged with these topics at both the objective terms of the information provided by the teacher, books and the Internet, and the

subjective terms of their imagination, will, judgement and critical thinking while creating their products. Through the production phase, they developed knowledge about ceramic craft objects. During the interviews, the products were used as examples in the students' reflections on environmental considerations in product design. However, the students had not experienced examples that visualise impacts between products and environments. This because, while their products and production had been present in school studio, had the impacts been absent, as these accumulate over time in environments elsewhere. In addition, the environmental impacts of products and methods of collecting or comprehending such information were not educational topics covered by the project, and such information was not mentioned in the interviews. As one of the students said, "I am not really sure how the vessels stand in relation to nature" (Ann). Still, engagement in environmentally considerate design required the students to use some knowledge about the impact of products on the environment. So, how could the students respond to the interview questions? The answer to this, lie in the knowledge that the interview questions did introduce. A knowledge on design method, which bridge the environmental contexts in product design for suitability.

Interview questions introduced *objective* knowledge on method of inquiry for product improvements to reduce negative impacts and support environmental sustainability. These questions were based on DfS principles and practices in professional design and design education. The LCT and TBL principles provided structure for inquiries about the aims, challenges and solutions of environmentally considerate product design. The TBL concerns the aims and accounts of achievements regarding environmental sustainability, including environmental quality, social equality and economic prosperity (Elkington, 1999), while the LCT concerns the product life cycle phases in which products can cause environmental impacts and where improvements can be made. In professional design and design education, DfS principles and practices are used comprehensively to improve products before the production phase. There, LCT forms the basis for life-cycle assessment (LCA) of the data concerning products' environmental impacts (Cooper, 2005; Heiskanen, 2002). Moreover, the LCA and TBL are used as principles to embed sustainability in the studio experience in professional design education (Giard & Schneiderman, 2013). However, the use of LCT has expanded from data collection and assessment among a few production experts to become a shared concept and useful tool in design-for-environment, environmental supply chain management, environmental labelling and environmental product policy, enabling communication and empowerment among people in general (Heiskanen, 2002). From the structured knowledge on life cycle phases, researchers in the field of professional product design developed the DfS practices of eco-efficiency, eco-effectiveness and durability to ensure that resource use supports aims for environmental sustainability. These practices provide objective knowledge concerning product design for sustainability, which I employed in the interview questions. My questions related to the students' use of ecological, human and material resources to create their product, and the products' qualities decisive for their impact on the environment.

The *subjective* terms related to students' critical thinking, judgement, will and imagination were enhanced through the group interview method, which involved semi-structured questions with open-ended answers and improvised elaborative and confirmative questions. These questions engaged the students in collaborative assessment of their use of resources and the qualities of their products that determined their use of resources. Moreover, they estimated the potential environmental impact of their use of resources and possible improvements. The students based their assessments on their experiences with the products and production process as well as the design knowledge they acquired on the distinctive characteristics of materials, products and production.

The students' *holistic knowledge* about their products' impact and performance in terms of environmental sustainability was developed and expressed through their reflections in the interviews. The data analysis illuminates how the students' experiences with the distinctive characteristics of materials, products and production provided them with basic design literacy

that allowed them to estimate environmental concerns. However, it was their environmental inquiries that broadened their horizons regarding the significance of design knowledge beyond the production phase in the school's studio. As one of the students said, "I don't think about it before someone asks me the question and I get to answer" (Ann). Thus, experience and reflection play complementary roles in knowledge development, echoing coherent perspectives by the late pedagogue John Dewey (Dewey & Dewey, 1915) and the late philosopher Donald A. Schön (1991). Holistic design knowledge—and design literacy for sustainability—are developed through engagement with examples of design practice and design thinking at both the objective and subjective terms. This underpins Nielsen and Brænne's (2013) argument that the environmental context should be included in craft and design to enhance design literacy for sustainability, moreover highlights the relevance of enhancing youths' design literacy through LCT and DfS practices in craft-based design education.

Design literacy for sustainable production and consumption

The overall purpose of enhancing students' design literacy for sustainability is to strengthen their ability to democratically participate in sustainable production, consumption and societal development (Nielsen and Brænne, 2013). Democratic participation requires competence to assess, reflect on and estimate consequences. As Klafki (1959/2001, 1985/2001) argued, education must enhance students' autonomy for self-determination, co-determination and solidarity in their present and future. Because students live both inside and outside the school context, this concern relates to societal development both in the educational system and beyond. I will start my discussion with the latter.

In everyday life, students are likely to handle more products purchased from a store than those they made themselves. Therefore, the main way they can participate in sustainable development is autonomy in sustainable consumption. But, how can education about LCT in craft-based design practices enhance students' design literacy regarding sustainable consumption? In the data analysis, I found that the students did not view their own products as saleable. However, through LCT, the students were able to estimate their products' influence on environmental sustainability based on the distinctive characteristics of the materials, product and production process. To reflect upon whether the materials in glazed ceramic products can be recycled, they drew upon their experiences regarding the materials and demonstrated the role of detailed material knowledge in their competence. They did not have answers to this question, but they understood how the consistency of materials changed throughout the production process. This knowledge supported their reflections on life cycle phases beyond the one they personally experienced.

The students' autonomy as stakeholders in sustainable consumption depends upon their application of design literacy for sustainability to their everyday lives. One such way this knowledge can be used in everyday life is when they encounter product information. Although international policy regulates producers' responsibility for reducing waste (European Union, 2008), waste reduction ultimately depends on consumers to make informed, sustainable choices. However, the most sustainable consumer choices are not always obvious. Firms are incentivised to engage in 'greenwashing' by promoting an environmentally friendly image through selective use of information about the positive and negative aspects of their environmental and social performance. In most cases, consumers do not have ways to assess information about the production of the products they use (Lyon & Montgomery, 2013). Therefore, consumers' competence to assess products is of substantial significance to sustainable consumption. Heiskanen (2002) highlights the usefulness of buyers and suppliers sharing the concept of LCT. With knowledge also about the possibilities and challenges of designing for eco-efficiency, eco-effectiveness and durability in products life cycles, students can understand that no single DfS practice can solve all the environmental challenges associated with a product. Rather, design strategies clarify what to expect from the design (McDonough & Braungart, 2013, p. 13). Youths' autonomy to recognise and estimate whether DfS strategies

fulfil their expectations, needs and requirements makes them less dependent on the product information selected and provided by manufacturers and, hence, more prepared for encounters with greenwashing.

Recognising the different DfS practices related to the product qualities and acknowledging their opportunities and challenges are essential for sustainable consumption and should be emphasised in design education. *Design for eco-efficiency* involves low use of resources in all phases of the products' life cycle, from the cradle to the grave. This approach allows one to reduce the direct negative environmental impacts of squandering resources (Cooper, 2005). *Design for eco-effectiveness* involves cradle-to-cradle recycling and distribution of resources, allowing one to increase the positive environmental impacts of recycling biological and technical resources. However, the material separation and recycling infrastructure requirements cannot always be met by current technology. According to Cooper (2005, 2010), the cradle-to-grave and cradle-to-cradle practices for resource productivity, which are driven by efficiency, can lead to 'green growth', with increased consumption and resource throughput in the user phase of the product's life cycle. Growth in the circular use of resources also produces resources for new purposes (McDonough & Braungart, 2009, pp. 77-82). *Design for product durability* and longevity is intended to ensure a long user phase in products' life cycle. This approach enables reduction of the indirect negative environmental impacts of rapid resource throughput in the user phase due to product replacement. These practices for slow consumption are driven by the idea of sufficiency, which can cause challenges such as recession and unemployment and therefore depends on public support for a system-wide shift towards highly skilled, craft-based production, repair and maintenance (Cooper, 2005, pp. 54-55, 2010, pp. 11-14). As production for household consumption has indirect environmental impacts worldwide (Ivanova et al., 2015), the environmental benefits of DfS practices are indispensable. However, they must have public support in order to be implemented.

In design for eco-efficiency, eco-effectiveness and product durability, the consumer is not aware of the resources saved throughout products' life cycle, except for those saved in user situations. In addition, it is uncommon for these resources to be mentioned in the product information, and they are not always measurable. The three DfS practices can be combined, but they do not always support each other. For example, designing for durability may require more materials than can be reconciled with the practice of designing for efficiency or may require parts to be assembled with strong glue, which reduces the possibility of disassembly for recycling.

In summary, design and material knowledge about the distinctive characteristics of materials, products and the production process as well as knowledge of LCT and DfS practices are fundamental for assessing the possibilities and challenges in product design. These are essential educational topics for youths, as they enhance students' design literacy for sustainability and ensure their autonomy for co-determination in sustainable production and consumption.

Co-determination in the development of education in craft-based DfS

Norwegian lower secondary education is in the process of including sustainable development as an educational topic in the school subject Art and Crafts. The overall aim of both political initiatives and research on this topic is to enable youths to participate in sustainable development of society. However, although sustainable development depends upon youths' participation, intellectual contribution and ability to mobilize (United Nations Conference on Environment & Development [UNCED], 1992, para. 25.1-25.2.), are students rarely involved in research regarding development of sustainability as an educational topic in craft-based design education.

This case study illuminates the significance of the students' participation and co-determination in the development of the field of knowledge. In their collaborative reflections,

they drew upon their experiences with a craft-based design project (which took 54 hours) and broadened their competence through LCT (which took approximately one hour). Their responses reveal the potential for embedding DfS principles and practices that correspond with the students' experiential learning into schools' studios. The case study starts with students' experiential learning and searches for relevant knowledge on the topic to include. This bottom-up approach contributes to the research on educational development, which has so far adopted a top-down approach to implementing sustainability in Norwegian craft-based design education for youth. The following brief overview of associated initiatives and research on Norwegian general education in design, crafts and sustainable development, structured on the curriculum inquiry framework, i.e. *ideological* political intentions, *formal* curricula, *perceived* interpretations, *operationalised* education and *experiential* learning (Goodlad, Klein & Tye, 1979, pp. 58–65; Nielsen, 2009, pp. 27–31), reveals a gap in the research-based knowledge on students' experiential learning.

The *ideological* intentions related to the implementation of principles, practices, knowledge, skills and values for sustainable production and consumption in education have been proposed by several initiatives. These include international initiatives for sustainable development (World Commission on Environment and Development [WCED], 1987, Chapter 4. para. 3.2.; UNCED, 1992, para. 36.3), education for sustainable consumption (ESC; United Nations Environment Programme [UNEP], 2010) and education for sustainable development (ESD; The United Nations Educational, Scientific and Cultural Organization [UNESCO], 2014, 2018). National initiatives include Norway's ESD associated strategy Utdanning for bærekraftig utvikling (UBU), which focus aside production (Det kongelige kunnskaps-departement, 2012; Utdanningsdirektoratet, 2006a) and omit the school subject Art and Crafts (Melkild, 2016).

The *formal* implementation of sustainability in the Norwegian core curriculum for primary, lower and upper secondary education was conducted in 1993 (Royal Ministry of Education, Research and Church Affairs, 1999, pp. 4, 45-48) and extended as a cross-curricular topic in the core curriculum that was passed in 2017 (Utdanningsdirektoratet, 2018). The curriculum for the school subject Art and Crafts in primary and lower secondary education included environmentally conscious use of materials in 1997 (Royal Ministry of Education, Research and Church Affairs, 1999, pp. 203-217), and the consequences of products' life cycle on sustainable development and the environment in the 2006. Environmentally conscious use, reuse and long-term use of materials are emphasised in a 2019 consultation paper on a new Art and Crafts curriculum (Utdanningsdirektoratet, 2006b, 2019).

The *perceived* perspectives in research concern the possibilities of youths' development of design competence for democratic participation in sustainable development and consumption by experiencing and reflecting upon the design and crafts practice (Digranes & Fauske, 2010; Illeris, 2012; Lutnæs, 2015a, 2015b, 2017, In press; Lutnæs & Fallingen, 2017; Nielsen, 2009; Nielsen & Brænne, 2013, Nielsen & Digranes, 2007, 2012). Empirical studies among teachers in Art and Crafts concern perspectives on cultivation of eco-literacy (Fallingen, 2014) and sustainable perspectives on material use (Idland, 2015).

Operationalised educational practices are investigated in an empirical study on assessment rubrics in lower secondary school and how they value responsible creativity in art and crafts classes (Lutnæs, 2018).

The *experiential* learning of lower secondary students has been empirically investigated in this paper on students' use of experiential learning from craft-based design in LCT. Other studies have examined students' perspectives on learning environmental concerns in Art and Crafts as a key issue for operationalisation of educational practices in DfS (Maus, 2017), and enhancement of youths' design literacy for sustainability in craft-based design education (Maus, 2019).

This overview of the research in the field coincide with Goodlad, Klein and Tyes' (1979) description of the operational and experiential domains as largely uncharted territory in

curriculum inquiries. In this case study, I take their advice and employ concepts for curriculum discourse, analysis and development that are similar to each other across the domains of the educational system. To examine experiential learning in relation to the formal intentions of curricula in general education, I employ concepts from professional education. I find that principles of LCT, TBL and the related DfS practices for eco-efficiency, eco-effectiveness and product durability are relevant in this context. Despite differences in the purpose, products and production methods between craft-based design in lower secondary education and professional design education at universities, the basic principles and practices of design and design education at the professional level proved to be a useful framework for education at the lower secondary level.

The students' participation with their own perspectives, are fundamental for the development of the education in the operational and experiential domains. The students' experiences with the educational practices and their critical thinking, judgement, will and imagination regarding this new educational topic, indicate how sustainability can be embedded the educational practice. Thus, they must participate in sustainable development of their education through autonomy, self-determination, co-determination and solidarity. The fields of education and educational research must ensure the democratic participation of students, as their contributions are indispensable.

Teachers' inclusion of students in the development of educational practices depends upon the teachers' qualifications. The teacher must not only engage the students in craft-based design practice, but also embed sustainability at both subjective and objective terms. The teachers' ability to do so depends upon their knowledge of fundamental DfS principles and practices and how these can be used in different craft-based design practices. I recommend that education for teachers in design, art and crafts focus on this topic in the future.

The field of research also plays a fundamental role in ensuring students' participation in research. In line with the overview of current research, operationalised education and experiential learning are nascent research topics. This case study presents the importance students' voices in research and the relevance of the design and material knowledge they have acquired at school in the studio. The results indicate the relevance of further research with focus from experiential learning of design practice towards the ideological aims of implementing principles, practices, knowledge, skills and values for sustainable development in education.

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References

Ceschin, F., Gaziulusoy, I. (2016) Design for Sustainability: An Evolutionary Review. *Proceedings of DRS 2016, Design Research Society 50th Anniversary Conference.* Brighton, UK, 27–30 June 2016. Retrieved from http://www.drs2016.org/059/

Chapman, J. (2009). Design for (emotional) durability. *Design Issues*, *25*(4), 29–35. Retrieved from https://www.mitpressjournals.org/doi/pdf/10.1162/desi.2009.25.4.29

Chapman, J. (2010). Subject/object relationships and emotionally durable design. In T. Cooper (Ed.), *Longer lasting products: Alternatives to the throwaway society* (pp. 61–76). Farnham, England: Gower.

Chapman, J. (2015). *Emotionally durable design: Objects, experiences and empathy* (2nd ed.). London, UK: Routledge.

Cooper, T. (2005). Slower consumption: Reflections on product life spans and the "throwaway society." *Journal of Industrial Ecology*, *9*(1–2), 51–67. Retrieved from https://onlinelibrary.wiley.com/doi/epdf/10.1162/1088198054084671

Cooper, T. (2010). The significance of product longevity. In T. Cooper (Ed.), *Longer lasting products: Alternatives to the throwaway society* (pp. 3–36). Farnham, England: Gower.

Det Kongelige Kunnskapsdepartement [The Royal Ministry of Education and Research]. (2012). *Kunnskap for en felles framtid: Revidert strategi for utdanning for bærekraftig utvikling 2012-2015* [Knowledge for a common future: Revised strategy for education for sustainable development 2012-2015]. Retrieved from https://www.regjeringen.no/globalassets/upload/kd/vedlegg/uh/rapporter_og_planer/strategi_for_ubu.pdf

Dewey, J., & Dewey, E. (1915). *Schools of tomorrow*. New York: E. P. Dutton & Company. Retrieved from https://archive.org/details/schoolsoftomorro005826mbp/page/n9

Digranes, I., & Fauske, L. B. (2010). The reflective citizen: General design education for a sustainable future. In W. Boks, W. Ion, C. McMahon, & B. Parkinson (Eds.), *DS 62: Proceedings of E&PDE 2010, the 12th International Conference on Engineering and Product Design Education - When Design Education and Design Research meet, Trondheim, Norway, 02.-03.09.2010* (pp. 364–370). Glasgow: Design Society. Retrieved from https://www.designsociety.org/publication/30179/The+Reflective+Citizen+–+General+Design+Education+for+a+Sustainable+Future

European Union. (2008). *Directive 2008/98/EC of the European Parliament and the Council of 19 November 2008*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0098&from=EN

Elkington, J. (1999). *Cannibals with forks: The Triple Bottom Line of 21st Century Business*. Oxford, UK: Capstone Publishing.

Fallingen, N. (2014). *Business as usual?- Hvordan kultivere økoliteracy i grunnskolefaget Kunst og håndverk og valgfaget Design og redesign?* [Business as usual? - How to cultivate eco-literacy in the school subject Art and Crafts and the optional school subject Design and Redesign?] (Master's thesis, Høgskolen i Oslo og Akershus, Oslo). Retrieved from http://hdl.handle.net/10642/2091

Fontana, A., & Frey, J. H. (2008). The interview: From neutral stance to political involvement. In N. K. Denzin & Y. S. Lincoln (Eds.). *Collecting and interpreting qualitative materials* (pp. 115–159). London, UK: Sage.

Giard, J., & Schneiderman, D. (2013). Integrating sustainability in design education. In S. Walker & J. Giard (Eds.), *The handbook of design for sustainability* (pp. 121–136). London, UK: Bloomsbury.

Goodlad, J. I., Klein, M. F., & Tye, K. A. (1979). The domains of curriculum and their study. In J. I. Goodlad (Ed.), *Curriculum inquiry: The study of curriculum practice* (pp. 43–76). New York, NY: McGraw-Hill Book Company.

Heiskanen, E. (2002). The institutional logic of life cycle thinking. *Journal of Cleaner Production*, *10*(5), 427–437. doi: https://doi.org/10.1016/S0959-6526(02)00014-8

Idland, H. M. (2015). *Materialbruk i faget Kunst og håndverk: i forhold til et bærekraftig danningsperspektiv* [Material use in the school subject Art and Crafts: In relation to a sustainable formation perspective] (Master's thesis, Høgskolen i Oslo og Akershus, Oslo). Retrieved from http://hdl.handle.net/10642/2714

Illeris, H. (2012). Nordic contemporary art education and the environment: Constructing an epistemological platform for Art Education for Sustainable Development (AESD). *Nordic Journal of Art and Research*, *1*(2), 77–93. doi:https://doi.org/10.7577/information.v1i2.221

Ivanova, D., Stadler, K., Steen-Olsen, K., Wood, R., Vita, G., Tukker, A., & Hertwich, E. G. (2015). Environmental impact assessment of household consumption. *Journal of Industrial Ecology*, *20*(3), 526-536. doi: http://onlinelibrary.wiley.com/doi/10.1111/jiec.12371/epdf

King, N., & Horrocks, C. (2010). *Interviews in qualitative research*. London: Sage.

Klafki, W. (1959/2001). Kategorial dannelse: Bidrag til en dannelsesteoretisk fortolkning av moderne didaktikk [Kategorialen Bildung: A contribution to a Bildung theoretical interpretation of modern Didaktik] (A. Gylland, Trans.). In E. L. Dale (Ed.), *Om utdanning* [About education] (pp. 167–203). Oslo: Gyldendal.

Klafki, W. (1985/2001). *Didaktikk og dannelsesteori – Nye studier* [Didaktik and Bildung theory – new studies] (B. Christensen, Trans.) Århus: Forlaget Klim.

Kvale, S., & Brinkmann, S. (2015). *InterViews: Learning the craft of qualitative research interviewing* (3rd ed.). Thousand Oaks, CA: Sage.

Lutnæs, E. (2015a). Imagining the unknown - Responsible creativity for a better tomorrow. *FormAkademisk*, *8*(1), 1–15. doi: http://dx.doi.org/10.7577/formakademisk.1404

Lutnæs, E. (2015b). Kritisk refleksjon og systemorientert design – Bevisstgjøring og endringskompetanse gjennom Utdanning for bærekraftig forbruk. [Critical reflection and system-oriented design – Awareness and amending expertise through education for sustainable consumption]. *FormAkademisk*, *8*(3), 1–16. doi: http://dx.doi.org/10.7577/formakademisk.1433

Lutnæs, E. (2017). Rethinking consumption culture: Educating the reflective citizen. In A. Skjerven & J. B. Reitan (Eds.), *Design for a sustainable culture: Perspectives, practices and education* (pp. 171–184). London: Taylor and Francis

Lutnæs, E. (2018). Creativity in assessment rubrics. In E. Bohemia, A. Kovacevic, L. Buck, P. Childs, S. Green, A. Hall, & A. Dasan (Eds.), *DS 93: Proceedings of E&PDE 2018, the 20th International Conference on Engineering and Product Design Education, Dyson School of Engineering, Imperial College, London. 6th - 7th September 2018* (pp. 506–511). Glasgow: Design Society. Retrieved from https://www.designsociety.org/publication/40842/CREATIVITY+IN+ASSESSMENT+RUBRICS

Lutnæs, Eva. (In press). Framing the concept design literacy for a general public. In Erik Bohemia, Gerda Gemser, Cees de Bont, Nuša Fain, & Rita Assoreira Almendra (Eds.), *Conference Proceedings of the Design Management Academy 2019.* London: Design Management Academy. Retrieved from https://designinnovationmanagement.com/adim2019/

Lutnæs, E., & Fallingen, N. (2017). Bærekraftig utvikling gjennom skapende praksis [Art and craft education for sustainable development]. *FormAkademisk*, *10*(3), 1–19. doi:http://dx.doi.org/10.7577/formakademisk.1825

Lyon, T. P., & Montgomery, A. W. (2013). Tweetjacked: The impact of social media on corporate greenwash. *Journal of Business Ethics*, *118*(4), 747–757. doi: https://doi.org/10.1007/s10551-013-1958-x

Maus, I. G. (2017). Developing holistic understanding in design education for sustainability. In A. Skjerven & J. B. Reitan (Eds.), *Design for a sustainable culture: Perspectives, practices and education* (pp. 157–170). London: Taylor and Francis

Maus, Ingvill Gjerdrum. (2019). Enhancing design literacy for sustainability among youth in crafts-based design education. *Techne Series - Research in Sloyd Education and Craft Science A, 26*(1), 93-108. Retrieved from https://journals.hioa.no/index.php/techneA/article/view/2851

McDonough, W., & Braungart, M. (2009). *Cradle to cradle: Remaking the way we make things*. London: Vintage Books.

McDonough, W., & Braungart, M. (2013). *The upcycle: Beyond sustainability — Designing for abundance*. New York, NY: Melcher Media.

Melkild, N. J. B. (2016). *Forbruk, miljø og bærekraft i utvalgte norske strategidokumenter om utdanning (2004-2015) - Utfordringer for Kunst og håndverksfaget.* [Consumption, environment and sustainability in selected Norwegian documents on strategies in education (2004–2015) — Challenges for the school subject Art and Crafts] (Master's thesis, Høgskolen i Oslo og Akershus, Oslo). Retrieved from http://hdl.handle.net/10642/3350

Nielsen, L. M. (2009). *Fagdidaktikk for Kunst og håndverk — i går, i dag, i morgen* [Art and crafts education: yesterday, today, tomorrow]. Oslo: Universitetsforlaget.

Nielsen, L. M., & Brænne, K. (2013). Design literacy for longer lasting products. *Studies in Material Thinking*, *9*, 1–9. Retrieved from https://materialthinking.org/papers/125

Nielsen, L., & Digranes, I. (2007). User participation - real influence or hostage taking? In E. Bohemia, K. Hilton, C. McMahon, & A. Clarke (Eds.), *Proceedings of E&PDE 2007, the 9th International Conference on Engineering and Product Design Education, University of Northumbria, Newcastle, UK, 13.-14.09.2007* (pp. 305-310). Glasgow: Design Society. Retrieved from https://www.designsociety.org/publication/28412/User+participation+-+real+influence+or+hostage-taking%3F

Nielsen, L. M., & Digranes, I. (2012). Designkompetanse i et gjennomgående utdanningsløp [Design competence in a thorough the educational pathway]. *Techne Series A*, *19*(1), 17–24. Retrieved from https://journals.hioa.no/index.php/techneA/article/view/394

Royal Ministry of Education, Research and Church Affairs. (1999). *The curriculum for the 10-year compulsory school in Norway.* Oslo: National Centre for Educational Resources. Retrieved from https://www.nb.no/items/URN:NBN:no-nb_digibok_2010032503005

Schön, D. A. (1991). *The reflective practitioner: How professionals think in action* (Vol. 2). Farnham, England: Ashgate Publishing.

Stahel, W. (2010). Durability, function and performance. In T. Cooper (Ed.), *Longer lasting products: Alternatives to the throwaway society* (pp. 157–177). Farnham, England: Gower.

United Nations Conference on Environment & Development (UNCED). (1992). *Agenda 21*. Retrieved from https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2014). *Shaping the future we want: UN Decade of Education for Sustainable Development (2005–2014)*. (Final report). Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000230171

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2018). *Issues and trends in Education for Sustainable Development*. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000261445

United Nations Environment Programme (UNEP). (2010). *Here and now! Education for sustainable consumption: Recommendations and guidelines*. Retrieved from http://www.unep.fr/shared/publications/pdf/DTIx1252xPA-Here%20and%20Now%20EN.pdf

Utdanningsdirektoratet. (2006a). *Bærekraftig utvikling: Utdanning for bærekraftig utvikling* [Sustainable development: Education for sustainable development]. Retrieved from https://www.miljolare.no/info/Barekraftig_utvikl_rapp.pdf

Utdanningsdirektoratet. [Norwegian Directorate for Education and Training.]. (2006b). *Læreplan i Kunst og Håndverk* [Arts and crafts subject curriculum]. Retrieved from https://www.udir.no/laring-og-trivsel/lareplanverket/finn-lareplan/lareplan/?kode=KHV1-01

Utdanningsdirektoratet [Norwegian Directorate for Education and Training.]. (2018). *Overordnet del av læreplanverket* [Core curriculum]. Retrieved from https://www.udir.no/laring-og-trivsel/lareplanverket/overordnet-del/

Utdanningsdirektoratet [Norwegian Directorate for Education and Training]. (2019). *Høring — læreplaner i kunst og håndverk* [Consultation paper — curriculum Art and Crafts]. Retrieved from https://hoering.udir.no/Hoering/v2/341?notatId=680

World Commission on Environment and Development (WCED). (1987). *Our common future*. Retrieved from http://www.un-documents.net/our-common-future.pdf

Article 3

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Enhancing design literacy for sustainability among youth in crafts-based design education

Ingvill Gjerdrum Maus

This paper discusses the case study Case Sveip, examining enhancement of students' design literacy for sustainability in craft-based design. In 2015–2016, 2 teachers and 26 8th grade students (aged 12–13), who were organized into action group 1 (AG1) and action group 2 (AG2), participated in an action research in a Norwegian lower secondary school. Practices from design for sustainability (DfS) were introduced to the students during their craft-based designing of bentwood boxes. Thereafter, they worked with DfS principles and practices in an associated project book with introductions, tightly structured tasks and self-evaluation questions. Video recording transcripts with timekeeping and observation notes from AG1 (18 lessons, total 27 hr) and the project book responses from AG1 and AG2 (N = 24) were thematically analysed. Among the outcomes were that DfS introductions, with an average duration of approximately 6 min, were embedded in five lessons during decision-making situations about the design in sketches, work drawings and material selection. Thereafter, during 90 min of project book work, when the students assessed their finished products. The students' self-evaluations indicated that they found DfS to be understandable and useful for their design and craft practice, education and future work. However, there were indications that they were further along in their development of design literacy in DfS practices for eco-efficiency and eco-effectiveness than for product durability. This can be attributed to the distinct characteristics of these DfS practices, which held different possibilities and challenges for the students' development of design literacy for sustainability.

Keywords: Crafts-based design, Design for sustainability (DfS), Education for sustainable development (ESD), Lower secondary education

Introduction

Public education in design is essential for sustainable development. General education is emphasised as a key factor in sustainable development (World Commission on Environment and Development [WCED], 1987, Chapter 4. para. 3.2.; United Nations Conference on Environment and Development [UNCED], 1992, para. 36.3). The reason is that sustainability goals depend upon public participation. The United Nations' (UN) Sustainable Development Goal (SDG) 12—*ensure responsible consumption and production patterns*—seeks to reduce waste generation through prevention, reduction, recycling and reuse (UN, 2015a, para. 12.1–12.c.). This requires design competence among the public. Associated international initiatives on education are *education for sustainable development* (ESD; The United Nations Educational, Scientific and Cultural Organization [UNESCO], 2014) and *education for sustainable consumption* (ESC; United Nations Environment Programme [UNEP], 2010). ESD aims to build the necessary knowledge, skills and values to develop solutions to sustainability challenges and, moreover, aims to implement sustainable development principles and practices in all educational programmes (UNESCO, 2014, pp. 3, 9). National initiatives have also been developed, including Norway's ESD associated strategy *Utdanning for bærekraftig utvikling* (UBU; Det kongelige kunnskapsdepartement, 2012; Utdanningsdirektoratet, 2006a). Another initiative is the inclusion of sustainable development and environmental considerations in design and crafts in the curriculum for the school subject *Art and Crafts* in Norwegian primary and lower secondary school (Royal Ministry of Education, Research and Church Affairs, 1999, pp. 203–217; Utdanningsdirektoratet, 2006b, 2019).

A reading of associated research on Norwegian general education in design, crafts and sustainable development through the curriculum inquiry framework, i.e. *ideological* political intentions, *formal* curricula, *perceived* interpretations, *operationalised* education and *experiential* learning (Goodlad, Klein & Tye, 1979, pp. 58–65; Nielsen, 2009, pp. 27–31), disclosed a focus at the researches' and teachers' perceived interpretations. The research shared the perspective that youth can develop design competence for democratic participation in sustainable development and consumption by experiencing and reflecting upon the design and crafts practice (Digranes & Fauske, 2010; Illeris, 2012; Lutnæs, 2015a, 2015b, 2017; Lutnæs & Fallingen, 2017; Nielsen, 2009; Nielsen & Brænne, 2013, Nielsen & Digranes, 2007, 2012). Some made connections to international and national initiatives; Illeris (2012) coined the concept Art Education for Sustainable Development (AESD) as potential approach in ESD, while Lutnæs and Fallingen (2017) studied practices in Art and Crafts as potential approaches in UBU. Lutnæs (2015a, 2015b, 2017) studied the potential to enhance critical thinking and creativity for the development of sustainable societies in connection with ESC. Empirical studies on the perceived interpretations among art and crafts teachers concerned the possible cultivation of eco-literacy (Fallingen, 2014) and sustainable perspectives on material use (Idland, 2015). *Operationalised* educational practice was investigated in an empirical study on assessment rubrics and how these value responsible creativity in the subject Art and Crafts in lower secondary schools (Lutnæs, 2018). *Experiential* learning among lower secondary school students was investigated in two empirical studies. One concerning student perspectives on learning environmental concerns in Art and Crafts as a key issue for the operationalisation of the educational practice in DfS (Maus, 2017). Another concerning students' use of experiential learning from craft-based design practice in life cycle thinking on their product (Maus, in press). The need to develop ideology into educational practice based on associated research (Digranes & Fauske, 2010, p. 366) and for empirical studies at all levels of education (Nielsen & Digranes, 2012, pp. 21–22) have also been pointed out.

This case study, Case Sveip, contributes to the field of knowledge at the operationalised level of educational practice and the experiential level of student learning in craft-based design for sustainability (DfS) in lower secondary school. DfS principles and practices were embedded in a woodwork project to study the following research question: *What possibilities and challenges are involved in enhancing design literacy for sustainability among youth through engagement with DfS principles and practices?* To clarify the terms and concepts employed, the theoretical framework for the development of the educational practice and the data analysis will be briefly presented before the elaboration of the case and the methods are described.

Theoretical framework

Design literacy for sustainability refers to the competence needed to understand and create DfS. The concept draws on Nielsen and Brænnes' (2013) description of design literacy as a competence for understanding and creating design in physical materials in the context of what supports sustainable environments. They emphasised the development of this competence through material creation and material knowledge in the contexts of purpose, use, production, transport, ecology and ethics. Moreover, the inclusion of ecological literacy in design (Nielsen & Brænne, 2013) in line with research by Stegall (2006), Boehnert (2015) and Lutnæs and Fallingen (2017). Other contexts discussed in recent research on design literacy are innovation (Pacione, 2010), citizenship (Nielsen & Digranes 2012, p. 18) and inquiries (Skov Christensen, Hjorth, Sejer Iversen & Blikstein, 2016). Design literacy concerns the competence acquired through design education at general and professional levels (European Design Leadership Board 2012, pp. 67–71).

DfS in product innovation (Ceschin & Gaziulusoy, 2016) is employed from the professional design field, as educational content on environmental considerations in the product design in Case Sveip. *DfS principles* that support embedding sustainability in the studio experience (Giard & Schneiderman, 2013)

are used. These include product life cycle thinking (LCT) concerning raw materials extraction, manufacturing, distribution, use and disposal (Cooper, 2005; Heiskanen, 2002) and the consumptions cycle concerning prepurchasing activities, acquisition, product use and disposal (Cooper, 2005). Furthermore, the triple bottom line (TBL) aims to achieve environmental sustainability with environmental quality, social equality and economic prosperity (Elkington, 1999). *DfS practices* are also used. These include sustainable design with an intergenerational sustainable development perspective (Keitsch, 2012). In addition, there are elaborative DfS practices for eco-efficiency, with the low use of resources from cradle-to-grave (Cooper, 2005, 2010), and eco-effectiveness, with the circular use of resources from cradle-to-cradle (McDonough & Braungart, 2009, 2013). Moreover, there are DfS practices for product durability and longevity through intrinsic product qualities, including resistance to wear; reliability; upgradability; high-quality materials; and robust, carefully assembled and repairable construction. Also, there are outer aesthetic qualities, including materials that age with dignity, signs of quality and crafted details (Cooper, 2005, pp. 61–63, 2010, pp. 8–11). In addition, there are functional product qualities (Stahel, 2010) and emotionally durable products, including living objects with subject-object attachment, which is enhanced through gifts and memories (Chapman, 2009, 2010, 2015, pp. 42–47).

The theory of knowledge employed in the present study concerns students' development of holistic knowledge through engagement with educational examples in situations, incidents or items, in both objective terms of general ideas, and subjective terms of critical thinking, judgement, will and imagination (Klafki, 1959/2001, 1985/2001, pp. 101–184). Edwards' (2015) quadrant model of task sequencing to promote learning was used to develop the examples used in the present study. The model includes the following four sequences: 1) *Introduction* of key concepts and modelling of ways to engage with key concepts. 2) *Tightly structured tasks*, which demand engagement with key concepts and ways of enquiring, with formative assessments for learning through self-evaluation against criteria on the knowledge revealed and the strategies employed. 3) *More open tasks* which enable learners to apply key concepts and ways of enquiring, such as open-ended problem solving activities involving ambiguity and risk. 4) *Demonstration of grasp* of key concepts and ways of enquiring, with a summative evaluation of learning (Edwards, 2015, pp. 20–24).

Action research in Case Sveip

The qualitative method of action research (Hiim, 2016; McNiff, 2013, 2014) is employed to construct the research data. In action research, actions are taken to improve practice. Claims about the attainment of these improvements are grounded in documentation, analysis and democratic participation (McNiff, 2013, pp. 89–130) with different contributions from the participants (Hiim, 2016).

The present case study participants included two teachers, here called June and Tor, who have subject specialisation in Art and Crafts and work in a Norwegian lower secondary school, along with 26 8th grade students (ages 12–13). The students were organised into two groups; action research group 1 (AG1) which comprised of 15 students, and action research group 2 (AG2) which comprised of 11 students. Finally, as the university researcher, I collaborated in the planning and conducted the observation, documentation and analysis of the data. The research was carried out with consent of the teachers, the students and their parents, along with the approval of the Norwegian Centre for Research Data. The participants were anonymised to protect the individual students and the names used in this article are not their real names. Consequently, their unique products were not included to avoid recognition. Unavoidably and unfortunately, anonymization deprive the participants of deserved credit (McNiff, 2013).

The case study focused on a craft-based design project to create bentwood boxes, called sveip in Norwegian, which June and Tor were developing to replace another long-running woodwork project.

Each student made a traditional bentwood box, with unique variations in his/her selections of the wood (ash or beech), size, shape, overlap, stitching (rattan or leather thread), lid and locking mechanism for the box. To complete this challenging technique, straight wood was soaked in water and bent into an oval or round shape, making a permanent change to the character of the material. The overlapping wood sections were glued and stitched, and a bottom, a lid and locking mechanisms were attached. Finally, the surfaces were treated with oil (Figure 1). The project was theoretically sampled for its challenging craft in materials, based on Nielsen and Brænnes' (2013) description of the development of design literacy through making in materials in the context of what support environmental sustainability. The teachers had experience in teaching woodwork, but not in teaching the environmental contexts. June had signed up on a list for teachers interested in participating in the research project, which involved getting help in developing DfS in their educational practice. The case was designed to embed experiential learning of DfS into the student's woodwork, thereby developing their design literacy for sustainability.

Figure 1. A bentwood box made by June as a model for the students' craft-based design practice.

Data construction and analysis using the action-reflection cycle

Action research is conducted in action-reflection cycles comprised of planning, acting, observing and reflecting on improvements in practice (McNiff, 2013, pp. 56–57, 105–118).

In the *planning phase*, June developed a model bentwood box (Figure 1), with assistance from Tor. In addition, June made instructions, learning objectives and assessment criteria. These were enclosed in a project book file in PowerPoint, together with DfS introductions, tightly structured tasks and open-ending self-evaluation questions that I developed in three stages. 1) *Defining of four overarching themes*: DfS introductions and tasks (Edwards, 2015), DfS principles and practices (Cooper, 2005, 2010; Elkington, 1999; Heiskanen, 2002; Keitsch, 2012), DfS practices for eco-efficiency and eco-effectiveness (Cooper, 2005, 2010; McDonough and Braungart, 2009, 2013) and DfS practices for product durability (Chapman, 2009, 2010, 2015; Cooper, 2005, 2010; Stahel, 2010). 2) *Development of seven interpretive themes* for the introductions and tightly structured tasks with the following project book headings: Design and sustainability; Functional design; Traditional design, unique details; Accuracy in craft; Materials with sustainable life cycle; Construction, repair and maintenance; and Value, price, wages and material costs. 3) *Development of four self-evaluation questions* on the students' experiential learning with the following project book headings: Difficulties, Usefulness of knowledge on sustainability and design, Problem solving for sustainable design and Crafts. The project book texts were in Norwegian, encouraging the students' responses in their own formulation. Technical terms, researchers' names and sources were omitted. During the project book development, June and I maintained an open dialogue; drafts were assessed by June and adjusted accordingly multiple times. In addition, two students assessed the project book before the students project book work in the last lesson.

In the *acting* phase, from August 2015 until January 2016, AG1 and AG2 each had 18 lessons of 90 minutes (total 27 hr) for a combined total of 36 lessons (54 hr). June taught 27 of these lessons, and Tor

taught six lessons as a substitute teacher. Two other substitute teachers taught one and two lessons, respectively. In lessons 1–17, which focused on craft-based designing of the bentwood box in the school studio, DfS was introduced by June and Tor when they found it expedient. In lesson 18, June and the students worked on the DfS introductions and tasks in the project book in a computer room. At no point did I act as a teacher.

In the *observation* phase, the data was documented in three ways: 1) I made video recording transcripts and timekeeping and observation notes of the DfS engagement sequences in AG1 (18 lessons, 27 hr). This data sample had little interference by non-participants, moreover represents the similar project progression in AG1 and AG2 that I documented in observation notes and video recordings from all the lessons in both groups. 2) The students recorded their task and self-evaluation responses in their project books (N = 24). Some responses referred to several themes, while four project books lacked some responses. Consequently, the data do not always sum up to 24. Two of the 26 students did not hand in their project books. 3) I made logs and memos from the meetings with the teachers.

The *reflection* phase involved quantitative and qualitative analysis of the data (McNiff, 2013, pp. 111–112). Thematic coding, which was inspired by interview analysis (King & Horrocks, 2010, pp. 142–174), was conducted in three stages: 1) *Descriptive coding* by anonymizing the data into coded, analytical units. 2) *Interpretive coding* of the data according to the seven interpretive themes: Design and sustainability; Functional design; Traditional design, unique details; Accuracy in craft; Materials with sustainable life cycle; Construction, repair and maintenance; and Value, price, wages and material costs. 3) *Organizing the data in the four overarching themes*: DfS introductions and tasks, DfS principles and practices, DfS practices for eco-efficiency and eco-effectiveness and DfS practice for product durability.

Measurability tends to focus on quantity rather than quality in education and learning (Hiim, 2016, pp, 150–151). However, the qualitative results of the timekeeping records and the students' responses should not be read solely with an effect-oriented approach to education; instead, they should be viewed within the qualitative outcomes of the project. The data were limited to the understandings expressed by the students and do not account for additional sources of the students' knowledge, despite the transdisciplinary nature of the topic.

The DfS educational practice and the student self-evaluation results

Organised according to the four overarching DfS themes described above, this section describes the educational practice outcomes, the students' engagement with the introductions and tightly structured tasks on the seven interpretive themes and the results of the student self-evaluations.

DfS introductions and tasks

AG1 used 25 of their 27 total study hours on making the bentwood boxes and 2 hours on introductions and tasks related to the DfS principles and practices. During the craft-based design practice in lessons 1–17, the students primarily focused on making their bentwood boxes in the school studio. In these lessons, the DfS principles and practices were introduced by June and Tor when they found it expedient. This occurred in five lessons, i.e. lessons 1, 2, 3, 4 and 8, with an average duration of approximately 6 min (1 min 30 s, 10 min 30 s, 14 min, 1 min and 2 min, respectively, for a total of 29 min). These instructions all took place during decision-making situations about the design in sketches, work drawings and material selection.

The project book work in lesson 18 was held in a computer room. In this lesson, the students participated in 30 min of mutual introductions and 60 min of project book work (total 90 min). This included responding to tightly structured tasks to assess the environmental considerations related to their boxes,

as well as uploading scanned drawings, work drawings and photos. In addition, the self-evaluation questions were completed, and the students had the opportunity to finish their project books at home. The coverage in lessons 1–18 of the introductions and tasks related to the DfS principles and practices is visualised in figure 2.

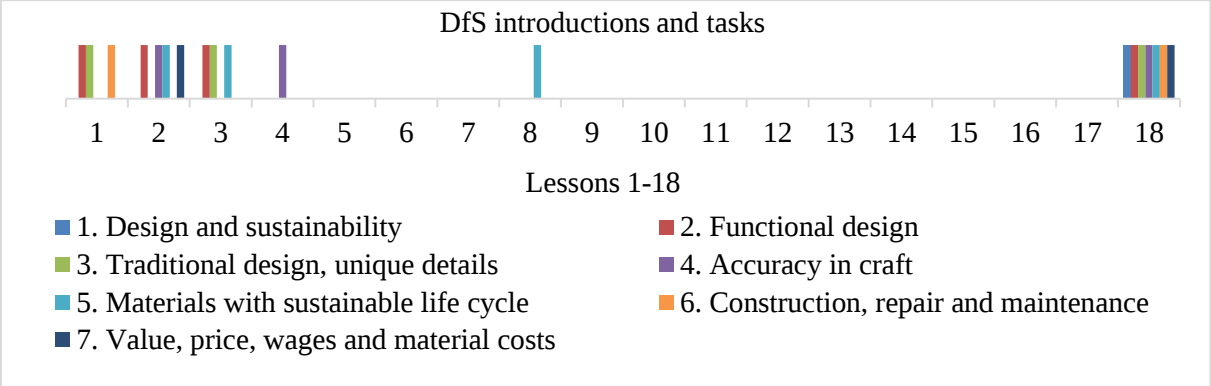

Figure 2. Clusters column chart on the coverage in lessons 1-18 of the introductions and tasks related to the DfS principles and practices.

According to their self-evaluation responses to the question, "Difficulties: Was there anything you experienced not being able to understand or manage in your work, and if so what was difficult?", the students found DfS to be understandable. The majority (n = 16) found nothing in the project they did not understand or manage, while a minority (n = 6) thought the details of the craft practice were difficult. None responded that DfS was difficult. Reading these responses in light of Edwards' (2015) model of task sequencing, the introductions and tightly structured tasks used in the present study successfully modelled ways of engaging with DfS in a craft-based design project to support student learning. The time allocated to the craft task supported the students in mastering the project's challenging and comprehensive craft practice. However, only a short time was spent on the project book work. June's evaluation of the project, documented in meeting memos, was that the students expressed little attachment to their project books after submitting them.

DfS principles and practices

Lesson 18 was the first and only time that June introduced the principles that guide DfS practices. She displayed the *design and sustainability* project book page on the projection screen, which was comprised of a SmartArt graphic of a segmented cycle of ecological, social and economic environments, with examples of product life cycles that support the sustainability of these environments. The graphic was based on the principles of LCT (Cooper, 2005; Heiskanen, 2002) and TBL (Elkington, 1999). It visualised examples of product life cycle impacts on environmental quality, social justice and economic prosperity, which could not otherwise be experienced in a school studio. Accompanying the image was one text box with bullets describing DfS practice (Cooper, 2005, 2010) and its intergenerational perspective (Keitsch, 2012). Another text box had bullets with information on unsustainable consumption in Norway (Fretex-gruppen, 2015), global population growth (UN, 2015b) and the idea that knowledge on product durability can help reduce consumption.

June drew on the students' experiences from the school studio to start a conversation on the graphic model. She asked what they remembered from their initial lessons. Ida referred to their talk in lesson 2 on materials with sustainable life cycle, saying, "I believe that it is to not use up the materials, that it renews itself later". June pointed at the ecological environment in the segmented cycle and confirmed the necessity of practicing sustainable material extraction from ecological resources. She explained the interrelatedness between production, use and disposal in ecological, social and economic environments. Another student responded that the economic aspects do not apply to their products, and June confirmed

that their school-made products differ from professional products. Next, she pointed to the bullets on unsustainable consumption and population growth and reminded the students that they had designed their products to reduce the risk of them becoming waste. Other students brought up examples of sustainable and unsustainable situations in their everyday lives. The students expressed understanding. of the topic while they participated in the conversation.

According to the self-evaluations, the students found DfS to be relevant for their own design and craft practices. On the question, "Usefulness of knowledge on sustainability and design: In which situations do you believe you can make use of knowledge on sustainability and design?", the majority (n = 17) referred to their design and craft practices in general or in their present and future education or professional life. A small minority (n = 3) referred to sustainable consumption, while only one (n = 1) stated that the knowledge would not be useful. Reading these responses in light of Edwards' (2015) model, most students experienced being able to make connections between key concepts of the DfS principles and practices and apply these to their own craft-based design practices.

DfS practices for eco-efficiency and eco-effectiveness

In lessons 1–17, June and Tor introduced practical interpretations of DfS practices for eco-efficiency, with the low use of resources from cradle-to-grave (Cooper, 2005, 2010), and eco-effectiveness, with the circular use of resources from cradle-to-cradle (McDonough & Braungart, 2009, 2013). In lesson 2, Tor facilitated a conversation on sustainable extraction, use and disposal of wood, while presenting the beech and ash wooden materials for the bentwood boxes. Tor asked what attributes the students associated with sustainable materials, and Erik suggested, "That it is strong". Tor confirmed the role of material solidity in the product user phase. Then, he asked questions on the origin, extraction and disposal of wooden materials. The students cited the possibilities of deforestation from wood extraction and regrowth, further incineration and decomposition of disposed wood. In response, Tor explained how wood is a renewable resource when supported by sustainable extraction, replanting of trees over generations and recycling through decomposition. The students brought up examples of the unsustainable extraction of wood from rainforests, and Tor elaborated on this with an example of the use of rainforest teak in products used in Norway. In lesson 3, June returned to the selection of efficient and functional materials for the product user phase when she explained the importance of selecting a wood type that does not add smell or flavour, particularly in boxes used for food storage. In lesson 8, June briefly revisited material extraction and recycling when she introduced the rattan and leather tread materials for the box seams.

In lesson 18, June returned to the DfS practices for eco-efficiency and eco-effectiveness. She displayed the *materials with sustainable life cycle* page on the projection screen. A text box on the left side introduced the life cycles of beech and ash, including extraction, user qualities for bentwood products and, moreover, the use and composting of wooden shreds. It also covered joint materials, including rattan, leather thread and non-biodegradable Polyvinyl acetate (PVAC) glue, as well as surface treatment materials, including a non-toxic oil that does not turn rancid, to prevent staining, drying and breakage. A text box on the right side held tightly structured questions on the students' material choices for the boxes and joints and the benefits of these. It also included possibilities for composting and recovering energy from the boxes if they were disposed of at some point.

June started with a question on the meaning of the term life cycle. Ida responded that it means "From the start until the end, when a tree starts growing, until someone cuts it down and we throw it away. The growth, death and disposal of a tree." June confirmed and elaborated on this topic before she asked the students what other materials they had used in their bentwood boxes. The students mentioned and asked questions on the materials they had used; why they had treated their boxes with oil; suitable types of oils for boxes intended to contain food; and the possibilities of composting, incinerating or reusing

materials from disposed wooden boxes that contain glue. Afterwards, the students responded to the questions in their project books; some expressed understanding of the challenges involved in composting glued wooden objects, while others found this question challenging. Rita wrote, 'Most of the box [materials] are wood, which means that it can be burned for heating and that it can be decomposed to soil. However, because the glue is plastic, it is not decomposable'. The students suggested cutting out and composting the parts without glue and incinerating or recycling the materials. They illustrated their materials by uploading a drawing they had made of the species of wood they had selected. For future student groups, ash will be substituted with other wood species. This because, during the year of this project, our data on the situation for ash became outdated. Due to a plant disease among trees, the status of ash was changed to vulnerable, the mildest grade of threatened species in Norway (Artsdatabanken, 2015).

According to the self-evaluations, the students associated design for eco-efficiency and eco-effectiveness with DfS rather than craft. On the question, "Problem solving for sustainable design: What is your experiential learning on choices in design, materials, construction and craft to reduce products' negative environmental impacts?", the majority (n = 17) referred to topics introduced in the interpretive theme Materials with sustainable life cycle. Their responses were distributed over all the life cycle phases, including extraction (n = 9), use (n = 6) and after use (n = 5). Meanwhile, on the question, "Craft: What is your experiential learning on the craft technique and the handling of materials and tools?", only a small minority (n = 2) referred to topics in the interpretive theme materials with sustainable life cycle. Reading these responses in light of Edwards' (2015) model, most students were able to recollect practices for eco-efficient and eco-effective use of materials in open-ended questions on DfS; hence, they would be able to try applying practices for eco-efficiency and eco-effectiveness in more open DfS tasks. In their task on the after use phase, they had already started engaging in open-ended problem solving activities involving combinations of materials in product design for recycling in ecological cycles through composting. The distribution of the self-evaluation responses over all life cycle phases could indicate that the DfS principle of the LCT on materials support their learning of DfS practices. However, the responses referring to the materials that were functional for the user phase, could also have been interpreted as referring to DfS practices for product durability.

DfS practices for product durability

In lessons 1–17, June and Tor introduced practical interpretations of DfS practices for product durability and long life span in the user phase (Chapman, 2009, 2010, 2015; Cooper, 2005, 2010; Stahel, 2010), while the students were designing their bentwood boxes in sketches and work drawings. In lesson 1, June told the students that they were to develop durable boxes and asked them how they could do that. The students responded that they had to make the boxes beautiful, solid and practical. In lesson 2, Tor told the students to plan their durable boxes by making a work drawing. Tina added, "If you are to make a box, than make a proper box, make it a little bit smart." Tor followed up with examples of planning the box in order to develop a functional size, avoid mistakes and dispose of half-finished products. Further, the intention of practicing skills and accuracy for development of emotionally valuable products. In lesson 3, June brought up design for functional and outer aesthetic product qualities. She asked students to read aloud from the project book text under the headings, *Functional design* and *Traditional design, unique details*. The students asked questions on the functional sizes and shapes of boxes to keep sewing equipment and cookies, which were the main intended uses of their boxes. Then, June explained how to develop unique designs in the traditional technique through sketches and work drawings. In lesson 4, June revisited the topic of product durability by asking about the purpose of planning a product. The students replied that the purpose was to develop a product with which they were satisfied. June responded that this could increase the likelihood of their keeping the product rather than disposing of it.

In lesson 18, June and the students returned to DfS practices for product durability. Five interpretive themes each headed a page in the project book; each theme had one text box with an introduction and another with tightly structured tasks.

The *functional design* theme introduced a practical interpretation of Stahels' (2010) description of the design of product qualities in functional tools to support product longevity. According to this theme, unpractical products are rapidly replaced and cause unnecessary product disposals. Further, bentwood boxes is traditionally used for the storage of small garments, decorative objects and food. The tasks for this theme concerned the students' planned use of the boxes and their design of the functional size and shape for the intended use. The students intended to use their boxes as containers for cookies, bakery items and other types of food, as well as for knitting equipment and silver jewellery for traditional costumes. Some had planned their boxes as decorative artefacts, and others had not decided on an intended use. Rita wrote, "I intend to keep cookies and Christmas cakes in it. I have designed the box for cookies, not too large but not too small either." The students illustrated the design with a scan of their work drawings.

The *traditional design, unique details* theme introduced a practical interpretation of Coopers' (2005) description of the design of outer aesthetic product qualities in crafted details to support product longevity. According to this theme, products we dislike and those which lack attachment are rapidly replaced. Further, historical trends in the decoration of bentwood boxes were introduced. The tasks for this theme concerned the design of the box details. The students described their decoration choices for the shapes of the seams, lids and locking mechanisms, as well as the selection of materials for the seams. Gina wrote:

> I made the locking mechanism reach all the way down. The lid is plain, without dramatic details. The overlap is shaped as a jigsaw-puzzle piece. The seam runs in a straight line down the middle. The only thing I regret is not using a fair colour on the seam to camouflage it more.

They illustrated their designs with detailed photos.

The *accuracy in craft* theme introduced another practical interpretation of Coopers' (2005) description of the design of outer aesthetic product qualities, such as signs of quality, to support product longevity. According to this theme, accuracy gives the box a professional appearance. The tasks for this theme concerned the craft details that the students considered to be of good quality and those they could have performed better. The students described the accuracy in the shape of the seam, the lid and the locking mechanism, along with the vertical positioning of the locking mechanism. Paul wrote, "I think I managed to make the locking mechanisms as I planned. But, I could have made the bottom of the box better, as it became uneven." They illustrated the quality of their crafts with detailed photos.

The *construction, repair and maintenance* theme introduced a practical interpretation of Coopers' (2005) description of the design of intrinsic product qualities, such as robust, carefully assembled and repairable construction, to support product longevity. According to this theme, products that are not solidly constructed or those that are difficult to repair or maintain are rapidly disposed of by users. The tasks for this theme concerned the construction of solid joints, weak points, possibilities for construction improvements and maintenance methods. Most students described the locking mechanisms as the weakest part of their boxes, and they also described how to maintain their boxes with oil. Magnus wrote, "The top of the locking mechanisms are slim, so these are the weakest points. One can glue them back on." They illustrated the topic with photos of the box joints.

The *value, price, wages and material costs* theme introduced a practical interpretation of Coopers' (2005) description of production for product longevity and sustainable consumption. Moreover,

Chapman's (2009, 2010, 2015) description of design for emotionally durable living objects, enhanced through gifts and memories, was also incorporated. The introduction of this theme focused on the earlier mass production of bentwood boxes, along with the costs and social consequences of today's mass production of storage boxes. In addition, emotional product value, independent of product price, was described. The tasks for this theme concerned the calculation of the production costs for the bentwood boxes, based on the material costs and an hourly wage example. Moreover, the students were asked why price examples for similar handmade and machine-made sales products were so much lower than the production costs of their boxes. Furthermore, the students were asked about whether they intended to keep their bentwood boxes or give them as gifts. The students expressed pride for and emotional attachment to their boxes, which they intended to either keep for themselves or give or share with family members. As Gro wrote:

> I might have used more time on it than was used on the one in the craft store. Then, it becomes more expensive because I have put more work into it, and the box I made is not mass-produced, so it is only one, and it is mine.

According to the self-evaluations, the students understood design for product durability, but associated it with craft rather than DfS. On the question, 'Problem solving for sustainable design: What is your experiential learning on choices in design, materials, construction and craft to reduce products' negative environmental impacts?', only a small minority (n = 2) referred to an interpretive theme within design for product durability; both of these respondents referred to accuracy in craft. Meanwhile, on the question, 'Craft: What is your experiential learning on the craft technique and the handling of materials and tools?', the majority (n = 22) expressed acquired learning craft practice for product durability. Most of these respondents (n =20) referred to accuracy in craft, while some (n = 4) referred to construction, repair and maintenance. Reading these responses in light of Edwards' (2015) model, most students were not applying design for product durability to open-ended DfS questions. Hence, they were unlikely to apply these in more open tasks involving open-ended problem solving activities with ambiguity and risk.

Possibilities and challenges

The students' self-evaluations reveal possibilities for the students' development of design literacy for sustainability. They found the DfS principles and practices comprehendible and relevant for their design and craft practice, education and future work.. However, they associated practices in design for eco-efficiency and eco-effectiveness with learning DfS, but they associated practices in design for product durability with learning craft. A comparison of this result with the timekeeping of the students' engagement with the different introductions and tasks, moreover their expression of understanding throughout the project does not explain this difference. However, as Jean McNiff (2013, p. 18) wrote, action research leads to new and interesting questions. This outcome indicate that the students found it more challenging to develop design literacy for sustainability on design for product durability than on design for eco-efficiency and eco-effectiveness. However, aspects of possible influence on the student experiential learning are the distinct characteristics of these DfS practices.

Discussion

The different characteristics inherent in design for product durability and design for eco-efficiency and eco-effectiveness may have influenced the students' learning. To visualise the differences, the students' engagement in these DfS practices is outlined in a modified version of a model for DfS educational practices (Maus, 2017), which employs Klafkis' (1959/2001, 1985/2001, pp. 101–184) perspectives on holistic knowledge development through student (the subject) engagement with an educational topic (the object). The triangular model (Figure 3) visualises the students' engagement with the DfS practices to reduce the school studio design products' (present object) negative environmental impacts (absent

object), which were absent from the school studio. With the aim of designing products with low negative environmental impacts, the influence between the design products and the environmental impacts was bidirectional with both affecting each other.

The practices used in design for product durability and design for eco-efficiency or eco-effectiveness employ different approaches to reduce products' negative environmental impacts. Design for eco-efficiency and eco-effectiveness seeks to reduce products' direct environmental impacts, while design for product durability seeks to reduce products' indirect environmental impacts by changing user behaviours regarding product acquisition, use, disposal and replacement. The triangular model (figure 3) visualises the implications of these different practices on students' engagement in the DfS and *development of design literacy for sustainability.*

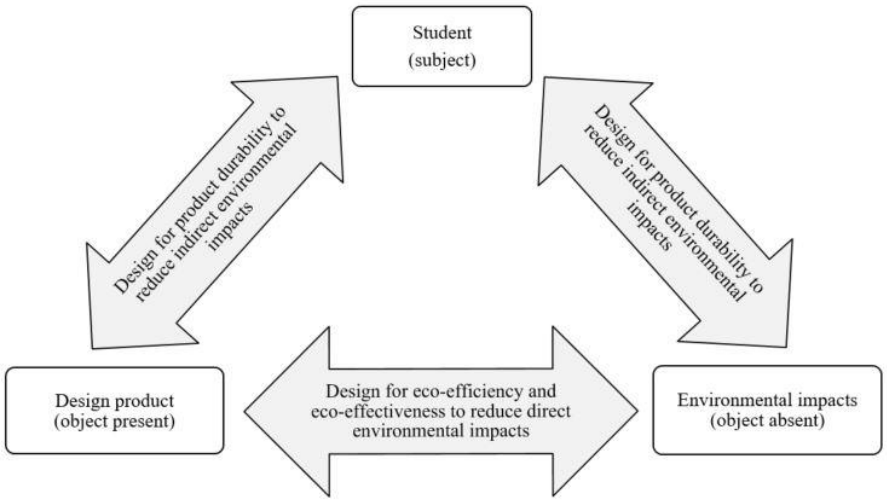

Figure 3. The model displays a variation in the use of the model for educational practice in DfS (Maus, 2017), which visualises engagement in design for product durability versus eco-efficiency and eco-effectiveness.

Design for product durability

Design for product durability involves the engagement of design qualities to achieve a positive and long-lasting relationship between the design product and the user, with the aim of reducing indirect environmental impact from disposal and product replacement. Chapman (2010, 2015) describes the subject-object relationship and focuses on design for emotionally durable products. Several product qualities, including intrinsic, functional, outer aesthetic and emotional qualities, affect the length of a product's life span. In design for product durability, the students engaged in the relationship between the design product (present object) and the product user—in this case, the student him/herself (subject)—to prevent the user from negatively impacting the environment (absent object) (figure 3).

Possibilities to enhance design literacy in design for product durability were present in the bentwood work, including designing product qualities that support a lasting relationship between a product and its user. The product qualities were experienced and observed by the students during their design and craft process. Thus, tangible examples and participation in DfS practice were present throughout the craft-based design project. Introductions of objective general ideas and questions for subjective critical thinking, judgement, will and imagination on these examples (Klafki, 1959/2001, 1985/2001, pp. 101–184) were developed with support from the research on design for qualities of durable products. This case study shows that the students expressed understanding during their engagement with the examples. Moreover, the students acquired knowledge and skills in the creation of durable products. However, challenges were equally embedded in this part of the case study. The focus on creating a lasting subject-

object relationship between the design product and the subject drew the focus away from the environmental context of the potential indirect environmental impacts caused by the user. Thus, only a small minority of the students' responses referred to design for product durability as part of their acquired DfS learning, their competence in this area does not match their competence in creating durable products. Hence, further engagement with the influence between the student and the environmental impacts are required.

The purpose of enhancing the students' design literacy in design for product durability is the application of sustainable development in their craft and design practices and their everyday lives. The environmental benefits of reducing resource throughputs in the user phase are supported by research on the indirect environmental impacts of product replacement (Ivanova et al., 2015). However, sustainable consumption requires knowledge, skills and values. The characteristics of durable products can be experienced during acquisition, use and repair. Design knowledge of these characteristics and their significance in reducing indirect environmental impacts can provide youth with autonomy in self-determination and co-determination and solidarity in the development of sustainable societies. In addition, reducing consumption depends on initiatives for redistributing employment from production to repair and service to avoid a recession (Cooper, 2005). Such initiatives will require co-determination and solidarity among the public. Thus, the practice of design for product durability is essential to the purpose of general education in design and ESD.

Design for eco-efficiency and eco-effectiveness

Designing for eco-efficiency and eco-effectiveness involves engagement in design with the aim of reducing products' direct environmental impacts. With reference to Chapman's (2010, 2015) description of the subject-object relationship in emotionally durable design, design for eco-efficiency and eco-effectiveness is described here as design for an object-object relationship. In design for eco-efficiency or eco-effectiveness, the students engaged in the relationship between the product (present object) and its environmental impacts (absent objects) (figure 3). Design for eco-efficiency seeks to reduce negative environmental impacts by minimizing the use of resources, including materials, water and energy, throughout the product life cycle from cradle-to-grave. Eco-effectiveness aims to recycle and generate resources throughout the product life cycle from cradle-to-cradle. Both design practices are guided by the principles of LCT and TBL.

The possibilities to enhance design literacy in design for eco-efficiency and eco-effectiveness are substantial. The focus of these DfS practices is on saving material resources to reduce the direct impacts of material use on ecological, social and economic environments. In the design for the user phase of the product life cycle, some eco-efficiency design practices can coincide or be combined with design for product durability, e.g. in this case study, the functional materials for the user phase. Other design practices can be irrelevant, e.g. in this case study, reducing energy and water usage in the user phase. The students in this case study expressed their understanding through engagement with examples of efficiency or effectiveness in material use, though not all of their suggestions were technically feasible. The students' engagement with the question concerning whether their glued wooden box could be composted demonstrates how craft-based design provides examples of ways to engage in feasibility and the need to develop materials and products for material recycling in ecological and technical cycles. The students learned about the use of materials throughout the product life cycle, which they considered relevant for their future. Challenges were equally embedded in this part of the case study. The focus on the flow of material resources in the product life cycle and the materials' environmental impacts reduced the design products to the sum of their materials. This focus concerned the object-object relationship between the design product and the environment, overlooking other aspects of environmental impact, such as the subject-object relationship between the design product and its user or how product use affects environments. Leaving out the product user might seem convenient if the user does not want to change

his/her behaviour. However, general education should not suggest that sustainable development does not involve product user participation or even expect that the public would prefer not to participate in sustainable development. After all, designing product qualities for the user phase in this case study enhanced student engagement.

The purpose of enhancing the students' design literacy within eco-efficiency and eco-effectiveness also concerns the application of sustainable development in their craft and design practices and their everyday lives. General education in design for youths aims to prepare them to participate as citizens in the development of sustainable societies (Digranes & Fauske, 2010); consumption cycles are a major aspect of this participation. In product encounters, the knowledge, skills and values of youths concerning eco-efficient and eco-effective use of materials throughout the product life cycle will fundamentally influence their ability to practice sustainable consumption. The risk of eco-efficiency leading to green growth with a high throughput of resources with an overall loss of resources rather than a savings (Cooper, 2005) is a possible challenge. Therefore, enhancing design literacy in eco-effectiveness and eco-efficiency serves, but does not fulfil, the purpose of general education in design and ESD.

Conclusion and the path forward

The possibilities to enhance design literacy for sustainability through DfS are numerous. Design literacy develops through engagement in the design and craft process in the environmental context of influences between design products and environmental impacts. Support for engagement with this environmental context, which cannot be observed during craft-based design practice in school studios, is to be found in the principles and practices within the professional DfS field. DfS practices for eco-effectiveness, eco-efficiency and product durability can be employed in tasks that are of less complexity then the problem solving practiced by professional designers. General education in DfS should facilitate students' participation *in* craft-based DfS practice at their level, rather than just teaching knowledge *about* professional DfS. Through practical work, with examples illustrating objective DfS principles and practices, students can use their subjective critical thinking, judgement, will and imagination to develop their design literacy for autonomy, self-determination, co-determination and solidarity in sustainable development.

In this case study, introductions and tightly structured tasks were employed to engage the students in DfS, with them expressing that they found DfS to be understandable and useful for their design and craft education and future work. Nevertheless, there were indications that the students were further along in their development of design literacy in DfS practices for eco-efficiency and eco-effectiveness than for product durability. They associated their learning of design for eco-efficiency and eco-effectiveness with DfS, but were unable to make the same association between DfS and product durability. One possible reason for this is the different characteristics of the DfS practices.

This case study responded to a call for empirical studies in the field, and the results were encouraging. However, DfS education is a broad field, and this case study only covers a few approaches. Therefore, further inquiries are recommended. In addition, the current highest priority is increasing competence in DfS education among teachers with subject specialisations in Art and Crafts, as these are the professionals who must translate the ideology of sustainability in design into educational practice to enhance design literacy for sustainability.

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References

Artsdatabanken. (2015). *Fraxinus excelsior L: Ask*. Retrieved from https://artsdatabanken.no/Rodliste2015/rodliste2015/Norge/102409

Boehnert, J. (2015). Ecological literacy in design education: A theoretical introduction. *FORMakademisk, 8*(1), 1–11. doi:10.7577/formakademisk.1405

Ceschin, F., & Gaziulusoy, I. (2016, June). Design for sustainability: An evolutionary review. Paper presented at the Design Research Society's 50th Anniversary Conference, Brighton, UK. Retrieved from http://www.drs2016.org/059/

Chapman, J. (2009). Design for (emotional) durability. *Design Issues, 25*(4), 29–35. Retrieved from http://www.mitpressjournals.org/doi/pdf/10.1162/desi.2009.25.4.29

Chapman, J. (2010). Subject/object relationships and emotionally durable design. In T. Cooper (Ed.), *Longer lasting products: Alternatives to the throwaway society* (pp. 61–76). Farnham, England: Gower.

Chapman, J. (2015). *Emotionally durable design: Objects, experiences and empathy* (2nd ed.). London, UK: Routledge.

Cooper, T. (2005). Slower consumption: Reflections on product life spans and the "throwaway society". *Journal of Industrial Ecology, 9*(1–2), 51–67. Retrieved from http://onlinelibrary.wiley.com/doi/10.1162/1088198054084671/epdf

Cooper, T. (2010). The significance of product longevity. In T. Cooper (Ed.), *Longer lasting products: Alternatives to the throwaway society* (pp. 5–36). Farnham, Surrey, England: Gower.

Det kongelige kunnskapsdepartement [The Royal Ministry of Education and Research]. (2012). *Kunnskap for en felles framtid: Revidert strategi for utdanning for bærekraftig utvikling 2012–2015 [Knowledge for a common future: Revised strategy for education for sustainable development 2012–2015]*. Retrieved from: https://www.regjeringen.no/globalassets/upload/kd/vedlegg/uh/rapporter_og_planer/strategi_for_ubu.pdf

Digranes, I., & Fauske, L. B. (2010). The reflective citizen: General design education for a sustainable future. In W. Boks, W. Ion, C. McMahon, & Parkinson B (Eds.), *DS 62: Proceedings of E&PDE 2010, the 12th International Conference on Engineering and Product Design Education - When Design Education and Design Research meet ..., Trondheim, Norway, 02.-03.09.2010* (pp. 364–370). Glasgow: Design Society. Retrieved from https://www.designsociety.org/publication/30179/The+Reflective+Citizen+–+General+Design+Education+for+a+Sustainable+Future

Edwards, A. (2015). Designing tasks which engage learners with knowledge. In I. Thompson (Ed.), *Designing task in secondary education: Enhancing subject understanding and student engagement* (pp. 13–27). London, UK: Routledge.

Elkington, J. (1999). *Cannibals with forks: The triple bottom line of 21st century business*. Oxford: Capstone Publishing.

European Design Leadership Board. (2012). *Design for growth & prosperity*. Retrieved from: http://europeandesigninnovation.eu/wp-content/uploads/2012/09/Design_for_Growth_and_Prosperity_.pdf

Fallingen, N. (2014). *Business as usual? Hvordan kultivere økoliteracy i grunnskolefaget Kunst og håndverk og valgfaget Design og redesign?* [Business as usual? How to cultivate ecoliteracy in the school subject, Art and Crafts, and the optional school subject, Design and Redesign?] (Master's thesis). Høgskolen i Oslo og Akershus, Oslo. Retrieved from http://hdl.handle.net/10642/2091

Fretex-gruppen. (2015). *Årsrapport 2014* [Annual report 2014]. Sandnes, Norway: Fretex Norge AS.

Giard, J., & Schneiderman, D. (2013). Integrating sustainability in design education. In S. Walker & J. Giard (Eds.), *The handbook of design for sustainability* (pp. 121–136). London, UK: Bloomsbury.

Goodlad, J. I., Klein, M. F., & Tye, K. A. (1979). The domains of curriculum and their study. In J. I. Goodlad (Ed.), *Curriculum inquiry: The study of curriculum practice* (pp. 43–76). New York, NY: McGraw-Hill Book Company.

Heiskanen, E. (2002). The institutional logic of life cycle thinking. *Journal of Cleaner Production, 10*(5), 427–437. doi: https://doi.org/10.1016/S0959-6526(02)00014-8

Hiim, H. (2016). Educational action research and the development of professional teacher knowledge. In E. Gunnarsson, H. P. Hansen, B. S. Nielsen, & N. Sriskandarajah (Eds.). *Action research for democracy: New ideas and perspectives from Scandinavia* (pp. 147–161). New York, NY: Routledge.

Idland, H. M. (2015). *Materialbruk i faget Kunst og håndverk: i forhold til et bærekraftig danningsperspektiv [Material use in the school subject Art and Crafts: In relation to a sustainable formation perspective]*. (Master's thesis), Høgskolen i Oslo og Akershus, Oslo. Retrieved from http://hdl.handle.net/10642/2714

Illeris, H. (2012). Nordic contemporary art education and the environment: Constructing an epistemological platform for art education for sustainable development (AESD). *Nordic Journal of Art and Research*, *1*(2), 77–93. doi: https://doi.org/10.7577/information.v1i2.221

Ivanova, D., Stadler, K., Steen-Olsen, K., Wood, R., Vita, G., Tukker, A., & Hertwich, E. G. (2015). Environmental impact assessment of household consumption. *Journal of Industrial Ecology*, *20*(3). doi: http://onlinelibrary.wiley.com/doi/10.1111/jiec.12371/epdf

Keitsch, M. (2012). Sustainable design: A brief appraisal of its main concepts. *Sustainable Development*, *20*(3), 180–188. doi: https://doi.org/10.1002/sd.1534

King, N., & Horrocks, C. (2010). *Interviews in qualitative research*. London, UK: Sage.

Klafki, W. (1959/2001). Kategorial dannelse: Bidrag til en dannelsesteoretisk fortolkning av moderne didaktikk [Kategorialen Bildung: A contribution to a Bildung theoretical interpretation of modern Didaktik] (A. Gylland, Trans.). In E. L. Dale (Ed.), *Om utdanning* [About education] (pp. 167–203). Oslo: Gyldendal.

Klafki, W. (1985/2001). *Didaktikk og dannelsesteori – Nye studier* [*Didaktik and Bildung theory—New studies*] (B. Christensen, Trans.). Århus: Forlaget Klim.

Lutnæs, E. (2015a). Imagining the unknown: Responsible creativity for a better tomorrow. *FormAkademisk*, *8*(1), 1–15. doi:http://dx.doi.org/10.7577/formakademisk.1404

Lutnæs, E. (2015b). Kritisk refleksjon og systemorientert design – Bevisstgjøring og endringskompetanse gjennom Utdanning for bærekraftig forbruk. [Critical reflection and system-oriented design—Awareness and amending expertise through education for sustainable consumption]. *FormAkademisk*, *8*(3), 1–16. doi: http://dx.doi.org/10.7577/formakademisk.1433

Lutnæs, E. (2017). Rethinking consumption culture: Educating the reflective citizen. In A. Skjerven & J. B. Reitan (Eds.), *Design for a sustainable culture: Perspectives, practices and education* (pp. 171–184). London: Taylor and Francis.

Lutnæs, E. (2018). Creativity in assessment rubrics. In E. Bohemia, A. Kovacevic, L. Buck, P. Childs, S. Green, A. Hall, & A. Dasan (Eds.), *DS 93: Proceedings of the 20th International Conference on Engineering and Product Design Education (E&PDE 2018), Dyson School of Engineering, Imperial College, London. 6th–7th September 2018* (pp. 506–511). Glasgow: Design Society. Retrieved from https://www.designsociety.org/publication/40842/CREATIVITY+IN+ASSESSMENT+RUBRICS

Lutnæs, E., & Fallingen, N. (2017). Bærekraftig utvikling gjennom skapende praksis [Art and craft education for sustainable development]. *FormAkademisk*, *10*(3), 1–19. doi: http://dx.doi.org/10.7577/formakademisk.1825

Maus, I. G. (2017). Developing holistic understanding in design education for sustainability. In A. Skjerven & J. B. Reitan (Eds.), *Design for a sustainable culture: Perspectives, practices and education* (pp. 157–170). London: Taylor and Francis.

Maus, Ingvill Gjerdrum. (in press). Developing design literacy for sustainability : Lower secondary students' life cycle thinking on their craft-based design product. *FORMakademisk*.

McDonough, W., & Braungart, M. (2009). *Cradle to cradle: Remaking the way we make things*. London: Vintage Books.

McDonough, W., & Braungart, M. (2013). *The upcycle: Beyond sustainability—Designing for abundance*. New York, NY: Melcher Media.

McNiff, J. (2013). *Action research. Principles and practice.* London, UK: Routledge.

McNiff, J. (2014). *Writing and doing action research*. London, UK: Sage.

Nielsen, L. M. (2009). *Fagdidaktikk for Kunst og håndverk — i går, i dag, i morgen* [Art and crafts education: yesterday, today, tomorrow]. Oslo: Universitetsforlaget.

Nielsen, L. M., & Brænne, K. (2013). Design literacy for longer lasting products. *Studies in Material Thinking*, *9*, 1–9. Retrieved from https://materialthinking.org/papers/125

Nielsen, L., & Digranes, I. (2007). User participation—real influence or hostage taking. In E. Bohemia, K. Hilton, C. McMahon, & A. Clarke. *Proceedings of E&PDE 2007, the 9th International Conference on Engineering and Product Design Education, University of Northumbria, Newcastle, UK, 13.-14.09.2007.* Glasgow: Design Society. Retrieved from https://www.designsociety.org/publication/28412/User+participation+-+real+influence+or+hostage-taking%3F

Nielsen, L. M., & Digranes, I. (2012). Designkompetanse i et gjennomgående utdanningsløp [Design competence in a thorough the educational pathway]. *Techne Series A*, *19*(1), 17–24. Retrieved from https://journals.hioa.no/index.php/techneA/article/view/394

Pacione, C. (2010). Evolution of the mind: A case for design literacy. *Interactions*, *17*(2), 6–11. doi:10.1145/1699775.1699777

Royal Ministry of Education, Research and Church Affairs. (1999). *The curriculum for the 10-year compulsory school in Norway*. Oslo: National Centre for Educational Resources. Retrieved from http://urn.nb.no/URN:NBN:no-nb_digibok_2010032503005

Skov Christensen, K., Hjorth, M., Sejer Iversen, O., & Blikstein, P. (2016). Towards a formal assessment of design literacy: Analyzing K–12 students' stance towards inquiry. *Design Studies*, *46*, 125–151. doi: https://doi.org/10.1016/j.destud.2016.05.002

Stahel, W. (2010). Durability, function and performance. In T. Cooper (Ed.), *Longer lasting products: Alternatives to the throwaway society* (pp. 157–177). Farnham, Surrey, England: Gower.

Stegall, N. (2006). Designing for sustainability: A philosophy for ecologically intentional design. *Design Issues*, *22*(2), 56–63. Retrieved from http://www.mitpressjournals.org/doi/pdf/10.1162/desi.2006.22.2.56

United Nations (UN). (2015a). *Transforming our world: The 2030 agenda for sustainable development*. Retrieved from http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

United Nations (UN). (2015b). *World population prospects. The 2015 revision: Key findings and advance tables* Retrieved from: https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf

United Nations Conference on Environment and Development (UNCED). (1992). *Agenda 21*. Retrieved from https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2014). *Shaping the future we want: UN decade of education for sustainable development (2005–2014)*. (Final report). Retrieved from http://unesdoc.unesco.org/images/0023/002301/230171e.pdf

United Nations Environment Programme (UNEP). (2010). Here and now! Education for sustainable consumption: Recommendations and guidelines. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/8011/-Here%20and%20now!%20education%20for%20sustainable%20consumption_%20recommendations%20and%20guidelines-2010Here_and_Now_English.pdf?sequence=5&amp%3BisAllowed=y%2C%20Chinese%7C%7Chttps%3A//wedocs.unep.org/bitstream/handle/20.5

Utdanningsdirektoratet [Norwegian Directorate for Education and Training]. (2006a). *Bærekraftig utvikling: Utdanning for bærekraftig utvikling [Sustainable development: Education for sustainable development]*. Retrieved from https://www.miljolare.no/info/Barekraftig_utvikl_rapp.pdf

Utdanningsdirektoratet [Norwegian Directorate for Education and Training]. (2006b). *Læreplan i Kunst og Håndverk* [Arts and crafts subject curriculum]. Oslo, Norway. Retrieved from https://www.udir.no/laring-og-trivsel/lareplanverket/finn-lareplan/lareplan/?kode=KHV1-01

Utdanningsdirektoratet [Norwegian Directorate for Education and Training]. (2019). *Høring - læreplaner i kunst og håndverk* [Consultation paper— Arts and crafts subject curriculum*]*. Retrieved from https://hoering.udir.no/Hoering/v2/341?notatId=680

World Commission on Environment and Development. (1987). *Our common future*. Retrieved from http://www.un-documents.net/our-common-future.pdf

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Errata list on the synopsis

Abstract, p. 1, line 9: insert ‘for’ before ‘sustainability’

Abstract, p. 2, line 1 and 8: ‘practice’ instead of ‘practices’

p. 9, line 5: insert ‘the’ before ‘educational’

p. 11, line 29: insert ‘for’ before ‘sustainability’

p. 12, line 23: ‘practice’ instead of ‘practise’

p. 18, line 27: ‘on’ instead of ‘,’

p. 36, table 2, line 4: insert ‘for’ before ‘sustainability’

p. 41, table 3, column 3, line 6: ‘transcripts’ instead of ‘transcribed’

p. 43, line 9: ‘practice’ instead of ‘practices’

p. 43, line 17: insert ‘.’ after ‘128)’

p. 50, line 25: ‘The Norwegian National Graduate School in Teacher Education (NAFOL)’ instead of ‘NAFOL’.

p. 54, line 16: insert ‘.’ after ‘products’

p. 59, line 7: insert ‘for’ before ‘sustainability’

p. 65, line 32: ‘Clune (2010)’ instead of ‘(Clune, 2010)’

p. 72, line 9: ‘planned’ instead of ‘planning’

p. 72, line 21: insert ‘for’ before ‘sustainability’

p. 74, line 32: insert ‘to’ before ‘UNESCO’

p. 78, line 9: ‘handling’ instead of ‘handlsing’

p. 85, line 7: insert ‘ https://doi.org/10.33114/adim.2019.01.224 ’ after ‘1304.’