Envisioning Future Scenarios: Teaching and Assessing Values-based Design Approaches

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Abstract. This article addresses the need for teaching materials and systematized methods for teaching and assessing values-based design approaches. We do so by suggesting the teaching activity *Envisioning future scenarios,* which is based on utopian and dystopian scenarios in line with values-based design approaches such as speculative and critical design and related to design fiction practices. The teaching activity is presented with learning outcomes, instructions for how to implement it, corresponding assessment activities and criteria, and illustrated by a teaching case description. The article ends with a discussion on how the learning outcomes, the teaching activity, and the assessment are brought together in line with the principles of constructive alignment. Through this, we argue that the shortcoming of teaching materials and systematized methods for teaching and assessing values-based design approaches, such as speculative and critical design, can be addressed by aligning intended learning outcomes with teaching and assessment activities, and by applying a general structural framework such as e.g. the SOLO taxonomy, for defining and evaluating learning outcomes. The suggested teaching and assessment activities can be applied in educational domains as diverse as product and service design, engineering, architecture, media and communication, human-computer interaction, socio-technical studies and other creative fields.

Keywords: Values-based design, critical design, speculative design, envisioning, education, constructive alignment.

1 Introduction

There are several design approaches related to the design of technologies that are explicitly based in values, in both process and product, such as e.g., value sensitive design [19], speculative and critical design [17], experiential futures [44], design fiction [46], adversarial design [47] and values-led participatory design [26]. Such design approaches have in common that they address the relations between human

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values and technology, and envisions potential widespread consequences, long-term effects, political and societal impacts of designs.

These design approaches are all well-established in design research, and more or less well-documented in methods or products. We also see a tendency that speculative and critical design approaches and related design fiction practices are increasingly finding their place within interaction design and technology design educational programmes [24], and so is teaching for values in design in general [21], [23]. However, the teaching and assessment resources are scarce [21], [23], [24]. Although speculative and critical design is highly inspiring for design students [22], [24], they have been criticized for its unclear method [4] and is therefore difficult to transfer into learning objectives and assessment criteria.

With this paper, we seek to address this need for resources for alignment between intended learning outcomes, teaching activity and assessment criteria for values-based design approaches. We do so by suggesting a teaching activity accompanied by two suggested assessment activities specifically focused on exploring future value scenarios, to evoke reflection and better understanding of potential consequences of a design. This teaching activity, *Envisioning future scenarios*, combines a values-based design approach with inspiration from utopian and dystopian scenarios as seen in speculative and critical design [3], [27]. The teaching activity is part of a larger collection of teaching and assessment activities published as an online open educational resource [52]. The whole collection has been iteratively developed using a three-phased generic model for conducting educational design research [32]. The *Envisioning future scenarios* teaching activity will here be presented, with corresponding assessment activities and criteria, and illustrated by a teaching case description where the teaching activity was implemented as a stand-alone activity in a bachelor level course in product design.

2 Background

2.1 Values-based Design Approaches

Speculative and critical design are values-based approaches, as the design process as well as the presentation and narrative around the design itself, opens up for reflection on existing cultural values, morals, and practices. As such, there are many connections to other fields dealing with values in design, such as, for example, value sensitive design [19] and values-led participatory design [26], to mention a few. Value sensitive design and values-led participatory design are focused on making ethics and values explicit and integrating them in the design process to, for example, handle value tensions as they appear [19], [26]. Approaches such as speculative and critical design focus more on challenging values and narrow assumptions about the role technology plays in everyday life [17], often through provocation, and put an emphasis on the ethics of design practice and explore alternative design values [4]. Design fiction operates more in the intersection of design and speculative storytelling [46], and uses the materiality and idioms of graphic, interaction, and product design, and frequently video, to prototype elements of a possible world; past, present, or

future [44]. Adversarial design provides design criticism for thinking about the relationship between forms of political expression, computation as a medium, and the processes and products of design [47]. Beyond the different foci of critical design, speculative design, design fiction, and adversarial design, discursive design instead targets the intellect, prompting self-reflection and igniting the imagination [48]. According to Dunne and Raby [16], "Critical Design uses speculative design proposals to challenge narrow assumptions, preconceptions and givens about the roles products play in everyday life. It is more of an attitude than anything else, a position rather than a method". As such, critical design is a research through design methodology that puts an emphasis on the ethics of design practice, reveals potentially hidden agendas and values, and explores alternative design values [5].

Common for all works in the area of Design Fiction, and closely related speculative and critical design, is that they generally follow the principles of fiction, creating a "What if?" scenario, often presenting utopian or dystopian worlds [27]. A utopia can be defined as an ideal community or an imaginary society or place that contains highly desirable or perfect qualities. A dystopia is, like utopia, an imaginary society or place set in a speculative future, characterized by undesired qualities and elements that are opposite to those associated with utopia. Design fiction, whether in the form of utopian or dystopian experiments, deals with the imagination and materialization of possible futures [27]. First, it enables us to think about the future; second, to critique current practice [3].

Fictional and scenario design approaches that challenge assumptions are often situated in terms of dichotomies and binaries, such as utopian versus dystopian interpretations of envisioning [36]. One such example is found in Mancini et al. [31], who make use of contravision to explore users' reactions to futuristic technology. Their findings show that the use of two systematically comparable representations of the same technology can elicit a wider spectrum of reactions than a single representation can. A method related to contravision is envisioning, which has been applied in design research for a range of different purposes. For instance, Rasmussen and Hemmert [35] explore the future of living with shape-changing interfaces by speculative scenarios as a method for envisioning future research directions, Kok et al. [28] envision the large-scale effects of their teaching, Reeves [36] investigates envisioning within the field of Ubiquitous computing, Nathan et al. [33] envision systemic effects on persons and society throughout interactive system design, just to mention a few. Weiser's iconic "The computer for the twenty-first century" [40] is also based on a kind of envisioning that is often formed through a dissatisfaction with the limitations of existing technologies [36]. A related area is also Design and futures, which examines different aspects of how the fields of design and futures studies/ foresight overlap [43]

As mentioned, speculative and critical design have been criticized for that its central concepts and methods are unclear and difficult to adopt [5], and can be tricky to apply systematically, and therefore also to teach and assess. Dunne and Raby [16], [17] have been criticized for just defining but not supporting the critical design concept: "While it seems to be a timely fit for today's socially, aesthetically, and ethically oriented approaches to HCI, its adoption seems surprisingly limited." [5].

Critical design can be implemented in the design process to expose assumptions, generate interesting questions, and discover new ideas [37]. We have also seen how it

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successfully can be used in interaction design teaching to reflect how a design might have an impact on broader societal situations and individual lives [22]. Incorporating such approaches into design education programmes can provide students with greater insight and learn what may happen if they do not take into account this aspect of designing [37]. There is indeed something to learn from the "dark side" of design thinking, particularly in the ways that it challenges assumptions and preconceived ideas about the role of technology and products in our lives [37]. However, while speculative and critical design approaches themselves are well documented and discussed, design researchers pay less attention to how pedagogical practices might be used in the classroom to foster critical reflection on new technologies [24], and ultimately help educate more responsible designers.

Lately, we have seen an increased interest in research on values in design [10], [37], however, also here the research is well-documented and highly developed, however, pedagogical practices and materials on teaching for values in design are scarce [21], [23].

1.2 Teaching and Assessing Values-based Design Approaches

While the pedagogical practices for teaching values-based design approaches are limited, to the best of our knowledge, this is even more limited when it comes to assessment in values-based design teaching. Generally, there are four types of assessment forms; summative, formative, authentic and ipsative. In summative assessment, the focus is on measuring the level of learning, typically against standardized criteria, by collecting, interpreting, and reporting evidence of learning [15]. In formative assessment, the goal is to provide feedback that moves students forward [25]. Theoretically, any assessment activity can be assessed summatively (e.g., by giving a grade) or formatively (e.g., by providing feedback). This includes traditional assessment activities such as examinations or design deliverables. However, there are two types more. Authentic assessment focuses on the value of students' learning in the "real world" (situated in context), translating school-based ideas to authentic situations and tasks [1]. Ipsative assessment compares a learners' current performances with their previous performances, making it a highly personalized form of assessment [25].

Knowledge (knowing), skills (doing), and attitudes (being) are the three main competency types related to learning [6]. Knowledge refers to the cognitive domain, and includes declarative knowledge, procedural knowledge, and strategic knowledge. Skills refer to the psycho-motor domain, related to doing or acting in practice. Skills and knowledge tend to go hand in hand. For example, to design a product, a designer must know how to apply their design skills, such as performing a brainstorm session, to carry out the design process. Typically, education focuses on conveying knowledge and teaching skills. However, in values-based design, it is important to consider attitudes as well, as it refers to affect, related to values and emotions [6]. When defining learning goals in design we need to transform terms such as "understanding", "creativity", "originality" and "being a responsible designer" to more specific, observable outcomes. A significant challenge then is to articulate learning goals that

promote these important cognitive, psycho-motor, and attitudinal attributes but at the same time provide some useful methods of measuring their achievement [13].

In constructive alignment [9], intended learning outcomes, teaching activities, and assessment are brought together, and have been successfully implemented in universities all over the world [30]. Constructive alignment is built on the idea that "learning is constructed by what activities that the students carry out; learning is about what they do, not about what we teachers do. Likewise, assessment is about how well they achieve the intended outcomes, not about how well they report back to us what we have told them or what they have read" [9]. The key issue for the teacher is to operationalize the desired high levels of understanding in ways that denote performances that can be elicited by teaching and learning activities, and that can be assessed authentically.

According to Biggs [8], this can be achieved in a four-step process. *Firstly*, to define intended learning outcomes that refer not only to content to be learned, but to what is to be done with that content and to what standards. This can be achieved by, for example, the five levels in the SOLO (Structure of the Observed Learning Outcome) taxonomy [7]. *Secondly*, to create a learning environment that is likely to engage the student in learning activities that will bring about the intended outcomes. *Thirdly*, to use assessment tasks that directly address the outcome and that enable you to judge if and how well students' performances meet the criteria. When teaching values-based design, teachers should look beyond the material learning outcomes. *Finally*, to transform these judgments into summative grades, however, in values-based design, grades as indicators of performance should always be accompanied by feedback, to allow assessment for learning.

Although constructive alignment is widespread in higher education around the world, also within the design of technologies [20] it has also received some criticism. Recently, it has been questioned whether constructive alignment can be used to align more complex, interdisciplinary based university programs, which requires a complex interdisciplinary approach beyond those found in most traditional education institutions [11]. It has also been argued that the mechanistic use of alignment and learning outcomes for validation purposes can create an illusion of quality control which bears little relation to the reality of teaching practice and student learning [30]. Acknowledging this critique, we still believe that the principles behind constructive alignment can be a fruitful method to structure the teaching also for interdisciplinary and complex educational contexts such as, for example, values-based design.

In a recent educational project, a total of 28 teaching activities and 12 assessment activities have been developed on teaching and assessing values-based design approaches, and specifically on the topic of values in design [52]. This work is part of an open educational resource on teaching for values in design, including learning objectives which outlines progression in values in design in accordance with the SOLO taxonomy [7]. The teaching materials also provide background information to each of the teaching and assessment activities, the intended learning outcomes, and step-by-step instructions for how to run them. Inspired by this structured way of designing and sharing teaching materials on values-based design approaches, this paper focuses on presenting one of these teaching activities with corresponding assessment activities, namely the *Envisioning future scenarios* teaching activity [52].

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3 Method

The development of the *Envisioning future scenarios* teaching activity and corresponding assessment activities are part of the work conducted in a three-year European project with academic partners from four universities in three countries. The result of the project is an open educational resource containing a collection of teaching activities with and assessment activities [52]. Through concrete activities, this collection is designed to inspire teachers in various types of design courses to consider incorporating value-based design approaches in their teaching. All these activities have been developed in parallel based on a three-phased generic model for conducting educational design research [32]. In the first phase, *Exploration and analysis*, we explored the domain of teaching and assessing for values in design by conducting a literature review. Furthermore, the method of pedagogical design patterns as a systematic educational development method was introduced.

In the second phase, *Design and construction*, the overarching learning objectives were identified and described, and SOLO taxonomy [7] was applied to learning objectives to support teachers in moving students' competencies from a beginner to an advanced level. In parallel, the project participants conducted two rounds of so-called pattern mining workshops to capture existing educational knowledge and practice. Through this, a selection of patterns was selected and developed using an adaptation of the pedagogical pattern method resulting in the design of 28 teaching activities cutting across the SOLO levels [7]. Furthermore, 12 assessment activities were designed to support teachers in evaluating whether the intended learning outcomes in the teaching activities were achieved by the students. For more information, see [52].

In the third and final phase, *Evaluation and reflection*, iterative peer-review of all teaching and assessment activities were carried out using a peer-review processes among project partners. This ensured multiple cycles of evaluation, reflection and revision of the activities throughout the project. Furthermore, the teaching and assessment activities were piloted stand-alone or in combination in various types of design educations (e.g., interaction and product design) across four countries. The case description in this paper derives from one of these pilots.

4 Envisioning Future Scenarios: Teaching and Assessing Value-based Design approaches

In the following, the *Envisioning future scenario* teaching activity is introduced by providing a brief background, presenting the intended learning outcomes and instructions for how to run it. Further on, two suggested assessment activities are described including assessment criteria that can be used to assess students' learning from partaking in the teaching activity. The suggested assessment activities are *Case-based assessment* and *Values-based exhibition or Public workshop*. The descriptions of both the teaching activity and the assessment activities take a similar form as how they are presented on the online open educational resource [52].

4.1 Teaching activity: Envisioning Future Scenarios

The teaching activity *Envisioning future scenarios* aims to create conditions for students to reach the competency level Extended abstract in the SOLO taxonomy [7]. At this level the students should have gained a deep understanding of the topic and may apply their knowledge in various contexts. This means that prior to this activity, students are expected to have gained knowledge in design, the role of values in design, and been introduced to various values-based design approaches.

When exploring users and user experiences, students may approach their own or others' designs from a single, narrow perspective without realizing its potential impact on a broader society. As evident, designs can have widespread consequences and long-term effects on various stakeholders beyond the stakeholders initially imagined, both in positive and negative ways. If designers lack understanding of the broad impact and long-term effects of their designs, they run the risk of inadvertently causing more harm than good in society.

In the *Envisioning future scenario* teaching activity, the students are asked to generate future scenarios to imagine and analyze potential widespread consequences, long-term effects and societal impacts of their own or others' designs. The students envision at least one use or user scenario, which goes beyond what they would normally describe as the intended use of their design and that may lead them to rethink their designs and design decisions.

The teaching activity builds on the Envisioning Cards [18], and uses envisioning prompts with accompanying questions as a tool for developing future scenarios to analyze and explain a use or user situation based on four criteria (stakeholders, time, values, pervasiveness). Each envisioning prompt draws students' attention to a particular socio-technical issue that is important yet easily overlooked (e.g., diverse geographies, political realities, obsolescence). Recommended literature for the students to read ahead of the activity is Nathan et al's article entitled "Envisioning systemic effects on persons and society throughout interactive system design" [33].

After the teaching activity, the students are expected to be able to (the intended learning outcomes):

- generate future scenarios to imagine and analyze potential widespread consequences, long-term effects and societal impacts of their own or others' designs,
- apply their understanding of potential widespread consequences and long-term effects to potentially rethink their design and design decisions.

How to run the teaching activity. The activity can run individually or in groups. Initially, the teacher gives a short introductory lecture on the importance of being conscious of the broad impact and long-term effects of a design. Some examples of utopian or dystopian scenarios using different media such as text (e.g., Isaac Asimov's Foundation series [2]) or video (e.g., a trailer of the Black Mirror episode on parental surveillance, Netflix [34]) can be used. The lecture should also introduce the envisioning prompts and the four criteria (stakeholders, time, values, and pervasiveness), each with accompanying questions (see Table 1), and preferably some example scenarios from the paper by Nathan et al. [33]. The examples from Nathan et al integrate the envisioning criteria with Carroll and Rosson's powerful scenario-

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based design (SBD) approach [50], discuss this approach in regards to Blythe and Wright's recent work on pastiche scenarios [51], and further shortly introduce to Design noir [49].

After the introduction lecture, the students select a project that they are developing (in group or individually), or an example design case that they can develop a scenario for. The expected result of the activity is at least one future scenario for the design. When imagining one or more possible future scenarios they use one or more envisioning prompts related to the four criteria. They may develop both utopian and dystopian versions of the future. While the students are working, it is important to highlight the fact that problems can be seen from multiple angles, and it is important to remind the students to think beyond a narrow utilitarian design perspective. The scenarios can be described in a short written story or as a video scenario.

When the students have developed their scenarios, they share and summarize insights from the teaching activity, and reflect upon their own designs and whether they think the scenario warrants some design changes. The result can be documented separately or as part of their design documentation.

Table 1. The envisioning prompts with examples of accompanying questions.

Prompt	**Questions**
Stakeholders	Identify Direct Stakeholders. In what key roles will individuals interact directly with the system? Create a list: • Identify Non-targeted Use. Who might use the interactive system for nefarious or unplanned purposes? In what ways? Identify three possibilities. • Identify Indirect Stakeholders. What are five roles that will be affected by the interactive system but will not directly interact with it? Make a list. • Consider Stakeholder Benefits and Harms. For each role from above, what are the anticipated benefits of interacting with the system? What are the potential harms or downsides?
Values	Choose Desired Values. Create a list of three values the design should ideally support. • Consider Values at Stake. Create a list of five values that are implicated by the design under consideration. • Possible values include (but are not limited to): autonomy, community, democracy, environmental sustainability, fairness, human dignity, inclusivity, informed consent, justice, privacy, self-efficacy, and trust.
Time	Reflect on Future Trends. Imagine five years into the future. The design that you are working on has been widely adopted and is part of daily life for both direct and indirect stakeholders across society. Consider the implications for: • How people do their work… • How people make and maintain friendships and family relationships… • Physical health and well-being… • Those who cannot afford the technology… • Norms and social expectations…

Pervasiveness	Consider Masses of Direct Stakeholders. Building from the earlier stakeholder activities, imagine a person in a given direct stakeholder role. Now imagine 10 such individuals interacting with the system. Then 100 individuals. Then 1000 individuals. What new interactions emerge from widespread use? • Consider Masses of Indirect Stakeholders. Imagine 100 to 1000 individuals in an indirect stakeholder role, all interacting with the system. What systemic interactions emerge now? • Identify Implications of Widespread Use. Imagine the interactive system in use in a particular place (e.g., a department in a university). Then imagine the system in use in five such places (e.g., five university departments). Then 100 such places. How might interactions change as the use spreads? • Consider Widespread Geographic Locations. Imagine interactive system use across regional geographies (e.g., rural areas within a state).

4.2 Assessment activities: Case-based assessment and Values-based exhibition or Public workshop

After having completed the teaching activity *Envisioning future scenarios*, two assessment activities are suggested for assessing students' learning: *Case-based assessment* (summative assessment) and *Values-based exhibition or Public workshop* (authentic assessment).

Assessment criteria

The suggested assessment criteria pinpoint what the students should be able to carry out to demonstrate that they have achieved the intended learning outcomes. When assessing the teacher may ask students to focus on:

- describing what envisioning prompts and criteria are relevant to apply for a specific case,
- imagining potential consequences, long-term effects and societal impacts of a design through a values scenario that goes beyond what would normally be described as intended use, using relevant envisioning criteria (including values) and prompts,
- analyzing the potential consequences of a design using relevant envisioning criteria (including values) through a values scenario and providing suggestions for how to mitigate negative consequences (e.g., in regard to re-design, further stakeholder dialogue, possible tensions) through rethinking the design.

These assessment criteria support the teachers in finding relevant questions and observation points related to the assessment of the students' learning. The criteria can be applied in the two suggested assessment activities that are based on two different assessment methods (summative and authentic). Both assessment activities address the competency type attitude (to be), which refers to the principles and beliefs that influence one's choices, judgements, behaviors, and actions and are related to values and emotions [6].

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Assessment activity: Case-based assessment. Case-based assessment is a summative method for assessing the students' attitude in relation to either their understanding of a specific theory applied to a (new) case, or how they would react in a certain situation. Instead of assessing through, for example, memorization, the students are asked to apply their acquired knowledge on a case. Case-based assessment thus reduces the possibility of the students simply remembering a key phrase.

When using a case-based assessment to assess students' learning from the *Envisioning future scenario* teaching activity, the students are asked to apply their learning about future scenarios on a case study. An example of a case can be an existing design, a situation, a scenario, or an example that has been used during teaching. The teacher can choose to either prepare the case or ask the students to find a relevant case themselves.

The assessment starts with the students getting an overview of the case. Thereafter, they apply the relevant envisioning prompts and criteria to analyze potential consequences, long-term effects or societal impacts of a design related to the case, and whether these insights led to a re-design of their concepts. The analysis results in a future scenario presented in a written story or as a video scenario (or any other relevant format). In comparison, when generating future scenarios during the actual teaching activity, the students' analyses should now also target the assessment criteria specified by the teacher and shared with them beforehand.

When performing summative assessment, the focus is on whether the students are able to sum up and address the intended learning outcomes relative to the specified assessment criteria. Summative assessment provides the teacher with information on the depth and breadth related to the students' learning. That is, are the students able to demonstrate and make visible what they have learned from partaking in the teaching activity?

Assessment activity: Values-based exhibition or Public workshop. Organizing a values-based exhibition or a public workshop is an authentic assessment method, which enables reflection through dialogue with external audiences or stakeholders. Exhibitions and public workshops require students to speak publicly, use evidence, present engaging visual displays, and otherwise demonstrate mastery to educators, peers, and others from outside the everyday school community [12]. At an exhibition or a public workshop, the students can share ideas and make their acquired knowledge explicit and visible to a community of practice. The assessment will include more voices and build a greater capacity for student learning.

When using this assessment method for assessing students' learning from the *Envisioning future scenario* teaching activity, the students are asked to organize a values-based exhibition or public workshop presenting: I) the original design and the case, II) their envisioning criteria and prompts and their particular socio-technical issues, and III) the developed future scenario and how it may make them rethink the designs.

When organizing the exhibition or workshop, the students are asked to consider the following questions:

– How can the external audiences or stakeholders be an active part of your demonstration?

– How can you, through your demonstration, invite the external audiences or stakeholders to debate the topic of values in design?
– How can you, through your demonstration, make the embodied values-oriented attitudes visible in your work?
– What kind of artifacts, visuals, flyers do you need to demonstrate your future scenario?
– How many activities do you need to demonstrate your future scenario?

When performing authentic assessment in the context of an exhibition or a public workshop, the focus should be on how the students, through engaging with a community of practice, can apply or integrate their knowledge in relation to the intended learning outcomes and the assessment criteria specified by the teacher. That is, are the students able to translate and reflect upon new knowledge that they have acquired through the teaching activity into real life practice, such as an exhibition or a public workshop?

5 Teaching Case description: Understanding Future Scenarios based on Stakeholders and their Values

The teaching case description presented in the following provides an example of how the teaching activity *Envisioning future scenarios* can be applied in practice in the classroom. Note that the case describes the use and result from the teaching activity only, not the two suggested assessment activities.

5.1 Educational setting

The *Envisioning future scenarios* teaching activity was conducted as part of a 10 weeks bachelor level course in Product design. The 27 students participating were divided into teams of 3–5 people and worked on projects with cases related to the theme of sustainability, such as e.g, recyclable product components, upcycling, packaging-free supermarkets, indoor food production etc. The course had a particular focus on the human aspects of a product as well as the real-life contexts in which a product is used.

Since the course happened during the pandemic period, the students worked remotely from their homes. All the teaching materials were presented to them via video conferencing and shared via a digital learning platform. The members of the student teams also collaborated with each other and stakeholders remotely via video conferencing and an online digital whiteboard.

5.2 Procedure

Previously in the course, the students had been introduced to the basic theoretical perspectives on the roles of values in design, and various design methods for conducting stakeholders research, prototyping etc., and the students ran various

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design activities to better grasp the human perspectives of a product: values, context, life situations. In week five of the course, while being in the middle of the idea development phase, a workshop focused on values in design was organized. The students were introduced to the *Envisioning future scenario* activity through a lecture with examples of various future scenarios and were asked to create utopian and dystopian future scenarios of their design concepts. The students got inspired by the Design with Intent toolkit [14] and were provided with the Envisioning cards [18] taking the criteria stakeholders, time, values and pervasiveness into account when creating their future scenarios.

Their assignment was to envision a minimum of three utopian scenarios and three dystopian scenarios of their designs. To help them in structuring their thoughts and in documenting their ideas, a specification sheet for future scenarios was provided (Fig 1). The future scenarios were described in a written form and provided a story about how their designs might work in the future in a real-world setting. The students were instructed to also reflect upon how the scenarios made them think critically about their designs and maybe even re-think some of the design features, or even modify some of the underlying values behind their design. The assignment was handed in as part of a series of weekly assignments.

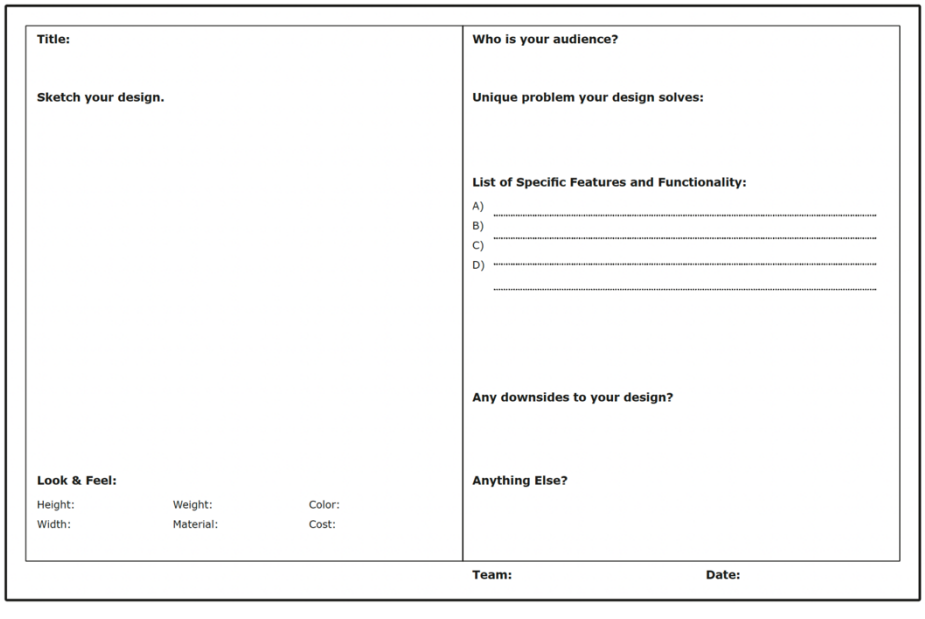

Fig 1. Future scenario specification sheet provided to the students.

5.3 Future scenarios developed by the students

A collection of dystopian and utopian scenarios was developed by the student teams, whereof a few examples are presented here.

One of the student teams worked on a concept for reducing food waste by opening a neighborhood grocery store that sells food close to expiry date to a reduced price. When creating their future scenarios, the students used some personas, such as an environmental activist and an elderly lady and used the same personas in utopian and dystopian scenarios. In their scenarios they considered which types of products (meat, vegetables) would work and how this kind of shopping affected both the consumers' self-image and food habits. This team did not reflect on what they learned from their scenarios, at least not from what could be read from the submitted assignment.

Another student team designed a mobile garden station for growing vegetables, allowing for people to collectively produce food locally in their apartment complex and reducing emissions caused by global transportation. In their future scenarios they considered the consequences for supermarket chains, and which types of products would no longer need to provide to their customers. They also considered how property developers would have to plan for huge terraces when building new housing areas, and how an increase of insects would have a negative effect on home environments. They also addressed the huge electricity consumption it would take to grow the food in the dark Scandinavian winters. In the students' reflection on their scenarios, they considered the social organization behind collaborative food production in shared areas and questioned what it would take to make it work between different apartment owners or renters. They also reflected on how much electricity such a garden station would need and if this extra electricity use would challenge the benefits of growing food locally.

The last example is a student team who also worked on a concept for gardening involving hydroponic gardening techniques. Besides developing future scenarios, they also provided a reflection upon how the scenarios made them re-consider aspects of their design, such as pricing, appropriate instructions for how to manage the product, how to clean it, extra features and parts that can replace broken parts and expansion of food production in the home through modules.

5.4 Assessing the students' learning

The teaching activity *Envisioning future scenarios* was part of a series of interrelated teaching activities conducted throughout the course period. Combined with other teaching activities, the activity created conditions for the students to reach the intended learning outcomes by allowing for reflections on ethical considerations, and potential effects, consequences, and impact on target groups, which might lead to re-design.

Summative assessment was used to assess students' learning from specifically partaking in the teaching activity *Envisioning future scenario*. The future scenarios developed were part of a weekly assignment that the students submitted to the digital course platform. The teachers provided written feedback based on the specified assessment criteria, and the assignment was graded with a Pass or Fail. The outcome of the *Envisioning future scenario* teaching activity also contributed to another assignment that the students were working on as part of the course. This assignment consisted of developing a flyer that presented both the product and its functionalities, and how it would fit into realistic user situations and everyday environments. When

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creating these flyers, the students translated and exhibited their acquired knowledge about the users and their everyday lives, and how they took this knowledge into account when designing their products.

The assessment criteria used for assessing the students' learning in the first assignment and partly in the second assignment, targeted the students' abilities to imagine potential consequences, long-term effects and societal impacts of a design. To pass the assignments, the students had to demonstrate an ability to develop such future scenarios, but preferably (not required to pass) also provide suggestions for how to reduce negative consequences through rethinking the design.

6 Discussion

There is a need to explore novel educational skills and practices for the 21st century, especially those focused on the critical relations between technology and people. With this paper, we seek to address two things, namely the shortcoming of teaching materials and resources for values-based design approaches, and the critique towards a lack of systematized methods for teaching and assessing values-based design. We do so by presenting the *Envisioning future scenarios* teaching activity with corresponding assessment activities, and a teaching case description where the activity has been applied. Through the suggested teaching and assessment activities, we argue that the lack of systematization within values-based design approaches can be addressed by alignment between intended learning outcomes, teaching activity and assessment, and by applying a general structural framework for defining and evaluating learning outcomes.

6.1 Constructively aligned Teaching and Assessment of Values-based Design Approaches

In brief, the basic principles behind constructive alignment are that students should construct knowledge through their own activities ("learning is about what they do, not about what we teachers do" [9]), and that there should be a clear link between the intended learning outcomes, the teaching activities, and the assessment [8]. The role of the teacher is to build learning environments that immerse the students and require engagement in teaching activities, and that the students' learning from partaking in these activities can be assessed. To discuss how (if) the *Envisioning future scenarios* and the two suggested assessment activities create conditions for such a learning environment we will use Biggs' [8] four step process on how to create learning environments where the intended learning outcomes, teaching activities, and assessment are constructively aligned.

The *first* step is about defining intended learning outcomes that do not only refer to the content to be learned, but what to do with that content [8]. In defining the goals of a specific activity, a general structural framework for evaluating learning outcomes can be useful as it enables us to compare learning goals between different subject areas and learning activities. In defining the intended learning outcomes for the

Envisioning future scenario teaching activity has been developed based on the SOLO taxonomy [7]. The learning outcomes are that the students will be able to:

- generate future scenarios to imagine and analyze potential widespread consequences, long-term effects and societal impacts of their own or others' designs,
- apply their understanding of potential widespread consequences and long-term effects to potentially rethink their design and design decisions.

To achieve these learning outcomes, it requires that the students actively work with the content. The analysis is conducted while generating future utopian and dystopian scenarios using the envisioning prompts and the related criteria. The students acquired understanding of the consequences and effect is applied when rethinking design concepts, and when coming up with alternatives to reduce negative impact.

The *second* step addresses the importance of creating learning environments that engage the student in learning activities that will support them in achieving the intended learning outcomes [8]. In the case of the *Envisioning future scenario* teaching activity, the teacher introduces the students to illustrative examples and methods for generating future scenarios, then the students construct knowledge primarily from engaging in the learning activity themselves, and not from what the teacher lectures about. It is not possible to achieve the learning outcomes by passively following the teacher, instead active engagement in the activity is a must.

An observation drawn from the teaching case description, is that the future scenarios generated by the students showed that not all students reflected deeply on how the scenarios made them re-consider aspects of their design. It became evident that the student teams needed in-class time, both during the work with the future scenarios, and also afterwards. The benefits of in-class work are that teachers can walk around between the students and pop into the group discussions and talk about the materials that they work with along the way. In this case, the teaching activity was run remotely due to the pandemic and the students and the teacher never met in the physical classroom, but via video conferencing and the digital learning platform. This experience and the results of the students' analyses and reflections points to the importance of the teacher's presence, even though the learning activity is student driven. Furthermore, as experienced from the case, teachers should dedicate time to follow up on the student work through plenum discussions, where everyone can reflect on each other's material. Perhaps through some sort of peer-review or opponent process.

The *third* step is about assessment, and the importance of using assessment activities that directly address the learning outcomes of the teaching activity, and that enable the teacher to judge if the students' performances meet the assessment criteria [8]. The two assessment activities that are suggested for assessing students' learning from the *Envisioning future scenario* teaching activity are Case-based assessment (summative assessment) and Values-based exhibition or Public workshop (authentic assessment).

In the Case-based assessment activity the students apply their acquired knowledge about future scenarios on a case study. That is, they are asked to re-run some elements of the teaching activity and generate future scenarios by imagining and analyzing

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potential consequences, effects, and impacts of a design related to a specific case. When generating the future scenarios, they should apply relevant envisioning prompts and criteria and focus on use or user scenarios that go beyond what is described as the intended use of the design. They are also asked to reflect upon whether these insights led them to re-think the design, and possibly also a re-design. Their future scenarios and potential re-designs are documented in a written format or as a video scenario. When performing the assessment activity, the focus is on to see whether the students are able to sum up the learning outcomes and demonstrate what they have learned from the teaching activity.

In the assessment activity Values-based exhibition or Public workshop, the students are asked to organize a values-based exhibition or a public workshop targeting external stakeholders. In doing so, the students are required to demonstrate their acquired knowledge to the public. When performing this kind of assessment activity, the focus is on how well the students manage to translate their new knowledge into real life practice, such as an exhibition or a workshop. For whatever type of assessment activity applied, it is important that the assessment criteria are shared with the students beforehand so they are aware of what they will be assessed upon. Also, that the suggested assessment criteria provided are directly connected to the intended learning outcomes and support the teachers in judging whether the learning outcomes are achieved.

In the teaching case description presented, none of these assessment activities were applied, but another kind of summative assessment activity where they submitted their future scenario as part of a weekly assignment, complemented with formative feedback to increase the opportunity for learning. When assessing the future scenarios it became clear that the future scenarios made some of the students think out of the box, and others not. Some of the students demonstrated how these insights led them to re-thinking their design concepts and ideas. The teacher learned that when introducing the students to this assignment, it might be useful to add a written or an oral reflection on how, for example, a dystopian scenario might help students to realize weak aspects of their design that they can improve. Only some of the student teams provided a written reflection on what they learned from the scenarios. By following up orally with an in-class discussion about their learning, all student teams could benefit from each other's critical reflections.

The *fourth* step is about how the teachers' judgments can be transformed into summative grades that indicate the students' levels of performance [8]. Besides having grades as an indicator of performance, we suggest that when teaching values-based design approaches the grade should always be accompanied by feedback in written or oral formats. In doing so, the students understand why or why not they achieved the intended learning outcomes and passed the course. There are no simple answers in the field of values-based design. To provide feedback beyond a summative grade may support students' learning about the complexities of the field, and support students' development of high levels of understanding also after the actual teaching activity is completed.

The description of the assessment activities presented say nothing about how the teachers' judgements should be transformed into grades since the standards for doing this greatly vary between different disciplines and university standards on national

and international levels. It is up to the teachers to adapt to their specific educational contexts.

When using Biggs' [8] four step process to reflect upon how intended learning outcomes, teaching activities, and assessment are linked, it became clear how difficult it is to design assessment activities for ipsative assessment types [25]. Ipsative assessment is a highly personalized form of assessment where progress is measured against the needs and goals of the individual, not in comparison to external standards or performances of peers. That is, it is about comparing an individual's current performance with her/his previous performance, and how her/his acquired knowledge has made her/him develop on an individual level.

Designing, understanding the potential consequences of a design, learning how to take responsibility for one's actions, and through that grow into a more caring and responsible designer of future technologies, can contribute to the development of the students' identity as professional designers. That is, their attitudes (being) as designers, which are based on the principles and beliefs that influence their choices, judgements, behaviors and actions and that are tightly connected to values and emotions [6]. Ipsative assessment can be applied to follow this learning progression and make the students reflect upon their journey in becoming a designer, and how they can contribute to society.

6.2 Limitations

An important question brought forward by Reeves [36] in relation to the *Envisioning future scenario* teaching activity remains unanswered: In using a particular envisioning prompt, what pathways might we be shutting down as possibilities, which endpoints might be excluded, which present issues are excluded? Other examples of envisioning prompts that are not included in this particular teaching activity, but that are nonetheless highly relevant, are prompts about the role of technology in particular places or in widespread geographic locations (such as in different cultures or rural areas). Also, the different knowledge systems of the West, the East and indigenous cultures and "ways of seeing" present very different ways of understanding human values [29], which can affect the way of working with value-based design. Certainly, there are many other prompts that can be used.

Also, we are aware that over time, the political significance of artefacts will change [38], [42], why envisioning once might not help over time. Envisioning has the potential to be a tool that can help in understanding potential consequences of technologies, although we should acknowledge that while envisioning can be applied by anyone, people may draw different conclusions depending on their own values.

There are many other facets of speculative and critical design, that have not been covered by the learning objectives for this specific activity, such as e.g., counterfactual scenarios, thought experiments, provocation through design, adversarial design and experiential futures. However, in follow-up activities for courses with a distinct focus on speculative and critical design, this would be the next step. The pedagogical approach from this paper could be used to develop learning objectives for these types of learning activities.

We acknowledge that every educational context is unique, and that learning is an individual activity: each of us learns at a different pace and has different cognitive

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abilities [41]. So far, we have only tested this teaching activity in interaction design and product design educations, so more testing is needed in other educational fields.

6 Conclusion

Based on the reflections put forward in this article, we argue that the shortcoming of teaching materials and systematized methods for teaching and assessing values-based design approaches, such as speculative and critical design, can be addressed by aligning intended learning outcomes with teaching and assessment activities, and by applying a general structural framework such as e.g., the SOLO taxonomy, for defining and evaluating learning outcomes. We firstly introduce the *Envisioning future scenarios* teaching activity, with two corresponding assessment activities, and illustrated by a teaching case description. The teaching activity serves as an example of how pedagogical practices fostering critical reflection on new technologies can systematically be designed, implemented and assessed. We then described how the intended learning outcomes, the actual teaching activity and the two assessment activities suggested for the *Envisioning future scenarios* activity are brought together in line with the principles of constructive alignment [8], and by applying the SOLO taxonomy [7]. The description serves as an example of how such an educational design approach can be applied to values-based design teaching and contribute to planning for complex educational contexts where many different parameters and disciplines come into play, for example, in product and service design, engineering, architecture, media and communication, human-computer interaction, socio-technical studies and other creative fields.

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