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Chapter 16 Exploring the potential of feedback within the creative processes of a design and technology classroom

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Introduction

Design feedback has the potential to greatly benefit pupils' creative design processes and the output they produce. When implemented effectively, critical comments and questions can support pupils' creative thinking processes by encouraging both generative and reflective thinking capabilities. In short, the use of design feedback within a classroom generally starts with a presentation of the design by the pupil designers after which those listening - peers, teachers, clients, and/or other stakeholders - voice their opinions and concerns (i.e. their feedback). Design feedback overlaps with the notion of 'critiquing', which in recent years is gaining more and more in design and technology education (Williams & Stables, 2017). Keirl (2021, p. 156) describes critiquing as follows: '... critiquing is the practice of questioning, judging and debating the relative merits of any design and/or technological product, process or system'.

Both design feedback and critiquing entail the act of questioning, judging and debating the merit of something. Within the design and technology classroom, this 'something' that is critiqued is generally the pupils' own design creations. When done right, these critiquing moments can lead to a valuable and constructive exchange

between the feedback giver and receiver. The goal of such an exchange is to help the designing pupil move their creative design process forward, leading to the development of their design into the ‘best defensible compromise’.

Despite the apparent benefits that feedback practices can bring to the creative processes in design and technology classrooms, it is not easy to create these valuable and constructive feedback exchanges. As a result, pupils are often not able to make adequate use of the feedback opportunities that are there, which in turn can hamper them in the creative development of their design (Schut, van Mechelen, Klapwijk, Gielen, & de Vries, 2020). Difficulties have been observed with feedback givers as well as receivers. For feedback givers forming relevant feedback can be challenging, while for the receivers handling and utilizing feedback is easier said than done. Whilst we can assume that design feedback is necessary, we cannot assume that pupils know how to make the most of this feedback. The issue, therefore, is not if we should use feedback in the design and technology classroom, but instead it is about the how and why of design feedback and the unintended consequences of poor design feedback practices.

In the next section I describe the nature of design feedback, then present the challenges and issues related to pupils giving and receiving feedback. The chapter concludes with a description of a recent study where we implemented a design feedback activity in two schools. The aim here is to not only raise issues around design feedback but also to provide inspiration for teachers wishing to implement, or improve, the use of design feedback within their pupils’ design projects.

The nature of feedback in creative design processes

The use of design feedback has a longstanding tradition within design disciplines at art academies and universities. The feedback moments within those contexts are generally known as design critiques (crits) or design reviews (Anthony, 1991). They are

considered to be one of the backbones to design education and practice (Gray, 2013). It is argued that through these critiquing moments novice designers are socialised into the discipline, thereby preparing them for the 'real world'. It is also recognized as a crucial means by which they obtain expertise from their teachers and other stakeholders in order to improve their design skills and abilities. In the end, the main goal of such feedback exchanges in an educational as well as in a real-world setting is to help move the designer's creative processes forward to improve the design and hand.

Designing is undeniably a creative process, as it confronts pupils with so-called 'wicked' problems for which no single 'right' answer or way of solving exists (Dorst, 2003). Therefore, they need to utilise their creative thinking abilities to explore the problem and generate and develop solutions (Lewis, 2009). It is commonly accepted that creative thinking can be divided into divergent thoughts (DT) and convergent thoughts (CT) (Goldschmidt, 2014). DT is generative in nature and entails the creation of new thoughts and ideas. CT is evaluative in nature and entails reflection and evaluation of thoughts and ideas. According to the dual-process theories of creative cognition a continuous shifting between both modes of thinking is needed when working towards a creative solution (Finke, Ward, & Smith, 1992).

Engaging in creative thinking is not an easy task, especially not for pupils who are new to the discipline. Difficulties can be caused by external factors, such as the learning environment, teacher beliefs, and examination requirements, but also internal factors such as pupils' personality, mindset and cognitive abilities. A rather well-known obstacle for creative thinking is the occurrence of design fixation, which can be described as sort of a mental block. Especially concept fixation - a type of design fixation which leaves designers stuck in a certain train of thought, adhering to the current possibly unfavourable state of their design – has been observed to impede

pupils' convergent and divergent thinking processes, thereby hindering continuous iterations in order to end up with the best defensible compromise (Schut, Klapwijk, Gielen, van Doorn, & de Vries, 2019). Design feedback can help stimulate and direct these creative thinking processes and mitigate obstacles like fixation, thereby supporting pupils' creative design processes.

As discussed, design feedback is generally focussed on the improvement and development of the design at hand. The set-up of these feedback moments is rather universal. It generally starts with some form of presentation by the student on their process and the status of their design to update their teachers, peers and other stakeholders (such as clients and/or potential users). Afterwards, this audience voices their opinions and concerns, often through a verbal dialogue, which allows the student to collect feedback (Oh, Ishizaki, Gross, & Yi-Luen Do, 2013). Ideally, this design feedback supports novice designers (pupils) with the critical reflection and evaluation of their design to help identify various shortcomings and sub-problems within the designs and, in turn, support the generation of new additions and alterations.

Unfortunately, this desired effect is not always accomplished. There are several studies at different educational levels that present how design feedback is not always shared in a constructive manner within the creative process (for example Cardoso, Eris, Badke-schaub, & Aurisicchio, 2014; Yilmaz & Daly, 2016). Additionally, pupils have also been observed to show resistance against the feedback they received, thereby rejecting or ignoring it. On occasion, even a state of defensiveness was observed as they tried to protect the current state of their design (Schut, Klapwijk, Gielen, & De Vries, 2019; Schut, Klapwijk, Gielen, van Doorn, et al., 2019). These studies are within the context of the current educational norm, which is that of unguided design feedback practices. Meaning that, commonly, the feedback giver and receiver have been given

little help in navigating the delicate and complex process of design feedback.

Additionally, the learning environment they are in does not always cater to the actual utilization of this feedback by the pupils. There are several challenges that can be outlined with giving design feedback as well as receiving feedback, which will be outlined in the two following sections.

Challenges with giving feedback

As described, design feedback can help push pupils towards divergent or convergent directions in their creative process. To have this effect, the feedback shared needs to be valuable and constructive. Meaning, it should be appropriate to the task at hand and formulated in a way that encourages openness from the receiver. Yet this is easier said than done. Obstacles in formulating design feedback have been observed on several educational levels. Issues that result from poor feedback formulation are for example interpretative challenges, and the non-stimulation of generative and evaluative thinking. Interpretive challenges on the design at hand and/or the feedback are problematic, as they can lead to a lack of shared understanding between the giver and receiver (Sadler, 2010). This lack of understanding can have consequences for the value of the design feedback. On the one hand, misconceptions about the design at hand by can lead to the construction of non-valuable feedback. After all, if the feedback giver does not fully understand the design, there the feedback will likely not be relevant for the receiver. This mismatch can heighten the resistance from the receiver towards the questions and comments that are shared. On the other hand, misinterpretation of the feedback by the receiver, or the inability to decode it, can lead to a rejection of feedback that could have otherwise been valuable.

As described in the previous section, design feedback can encourage and stimulate pupils' generative and evaluative thinking, thereby pushing them towards

divergent or convergent directions within their creative design processes. The design feedback itself can also be classified as divergent or convergent. This means that the questions and comments the feedback consists of can be generative or evaluative in nature. Examples divergent questions are: *'What if the design could be used outside?'* and *'How can we make the design even more appealing?'*. Examples of convergent questions are: *'What material is this part supposed to be made of?'* and *'What if people would pull this handle instead of push it?'*. Although it could then be assumed that divergent feedback will push pupils towards generation and convergent feedback will push towards evaluation, this has been found to not be the case (Schut, Klapwijk, Gielen, & De Vries, 2019). Rather, as a feedback giver it is important to be aware of the intended direction to push towards and consciously alternate divergent and convergent feedback until this goal is reached.

Both divergent and convergent feedback are considered essential and especially the combination of both types is found to be needed when intending to stimulate creative thinking processes (Schut, Klapwijk, Gielen, & De Vries, 2019). However, studies show that feedback givers - teachers, clients or peers - naturally have a strong focus on feedback pushing in convergent directions (Cardoso et al., 2014). Even though this often does not evoke the expected moments of critical reflection and evaluation. Instead, too much focus on convergence can lead novice designers to continuously try and prove the relevance of their design even become defensive. This links back to the occurrence of concept fixation, which entails a designer's (unconscious) adherence to the current possibly unfavourable state of their design. Berger (2009, p.58) labels a design that only the designer loves as 'a dinosaur baby', a 'quirky and idiosyncratic design creation that is destined to be loved by only its designer'. Additionally, this excessive focus on convergence creates a lack of divergent feedback and thereby the

prospective orientation - e.g. the feedforward component. Divergence can be seen as the driving force behind exploratory thinking and risk-taking, which are essential in creative design (Yilmaz & Daly, 2016).

Being aware of this discrepancy between convergent and divergent feedback and striving to pose more feedback that elicits divergent thought processes is therefore essential. In stimulating divergent thoughts openness can be brought back into the feedback exchange.

Challenges with receiving feedback

In the previous section, I outlined the challenges with giving feedback and some suggestions how this could be mitigated. Nonetheless, it is not solely the responsibility of those giving feedback to make the exchanges meaningful. After all, in the real world a designer will be repeatedly confronted with people who have little experience in giving constructive and valuable feedback. It is part of a designer's skillset to handle all kinds of feedback and know how use it to benefit themselves and the design they are working. For that reason, measures that help pupils process and make sense of feedback are equally important. Novice designers need to have the opportunity to learn how to construct as well as how to receive feedback from an early age and practice this within the save environment of the classroom. In terms of learning how to receive and process feedback, this brings us to the notion of feedback uptake and feedback literacy.

As described, a crucial goal behind design feedback exchanges is the utilisation of this feedback by novice designers to evaluate, adjust and improve their design is. In the context of non-design oriented higher education, the utilisation of feedback by the learner is known as feedback uptake. This concept goes beyond passive informing by the feedback giver and emphasises the active role learners need to take in order to

progress – for more details see (Carless & Boud, 2018). To become active receivers, pupils need to acquire certain competences and dispositions, which is known as the notion of feedback literacy. Carless and Boud (2018) describe a set of four key capacities and dispositions feedback literate learners need to have, being: appreciating feedback, managing affect, making judgements, and taking action. Building upon their work, Schut et al. (2022) modified these concepts for the context of design education into a process-oriented model of design feedback uptake.

In short, design feedback uptake can be defined as: novice designers taking an active role in utilizing feedback to inform their future design moves, ultimately leading to the development and improvement of their design. The process of design feedback uptake can be described as a chain of events, in which there is an overlap with the capacities and dispositions attributed to feedback literate learners. In figure 16.1 a process model of design feedback uptake is showcased.

[insert 03_Ch16_Fig16.1 here]

Figure 16.1 Process model of design feedback uptake, the (active) role of the receiver (Schut et al., 2021)

When design feedback is given, pupils initially have to balance their emotions. This can be viewed as the ability to balance between staying open to the possibility of being misdirected in your creative process, while also holding on to that which you believe still holds (creative) value in the face of criticism. This balance interacts with the ability to make evaluative judgements, which entails the sense-making of the feedback and deciding on the relevance and value it has for the creative design process. The result of a genuine and well-considered evaluative process is either the acceptance or rejection of the feedback in question. If the feedback is taken on board, this decision is followed by the pupils taking action, e.g. starting a redesign activity through the

stimulation of their divergent and convergent thinking processes. Finally, there is the element of ‘appreciating feedback’, which we propose has a more overarching position. While the other elements of the model can be viewed on a process level and are more directly influenced by the quality of feedback that is given. We argue that a pupil’s appreciation of design feedback and their understanding of its value is, generally speaking, not directly affected by a singular piece of ‘bad’ feedback.

As shown through the previous discussion, pupils are not able to just take an active role within the design feedback processes. Creating this change in handling design feedback requires attention, the right conditions, and a lot of practice. Primary school pupils need to receive guidance when engaging in design feedback processes.

Implementing design feedback practices in the classroom

So how could design feedback, especially peer feedback, actually be implemented in the design classroom? In this section an example is given of the results of a peer feedback intervention that was developed as part of the research project Co-Design with kids:

Early mastering of 21st century skills, which was implemented in two case-studies at two primary schools in the Netherlands. Two classes of pupils (9-12 years old) from each school participated in a design project in which they solved a real-life design challenge presented to them by real clients during the span of six design sessions.

Details of where the resources can be found online are at the end of this chapter. The peer feedback intervention entailed an elaborate procedure which was interwoven through several design sessions. Table 1 gives an overview of all design sessions and highlights key moments of the peer feedback intervention. It combined the principles described in the previous sections to create a learning environment that would encourage pupils to take an active role in the design feedback process, thereby enabling their feedback uptake. So how was this done? Below is a description of the main

components of the intervention – for more detailed information and academic grounding see Schut et al. (2020; 2022).

Table 1: Overview of the design sessions and key moments in the peer feedback intervention.

<i>Design Session</i>	<i>Content</i>
<i>Session 0</i> Introduction & Sensitizing	The start of the design project is announced with a short introduction. Pupils receive sensitizing assignments to do at home to trigger reflection about the design theme.
<i>Session 1</i> Exploring the design theme	Introduction to the design cycle and key design skills. The client(s) introduce the design theme. Pupils explore the design theme through stories.
<i>Session 2</i> Defining a point of view	Introduction to problem defining. Pupils define a design scope with design question, and design criteria.
<i>Session 3</i> Ideation, selection & detailing	Pupils ideate guided by brainstorming tools. Pupils select ideas guided by selection tools. Pupils detail selected idea with an elaboration tool.
<i>Session 4</i> Feedback design ideas Design critiques	Pupils present their design idea and receive oral and written feedback from the client(s) and their peers. Pupils participate in peer feedback exchanges.

<i>Session 5</i> Concept development & elaboration	Pupils are prompted to discuss, evaluate and utilize the written feedback from the client(s) and their peers to improve and develop their design idea. Pupils build models or prototypes to represent and develop the design idea.
<i>Session 6</i> Feedback prototypes Design critiques	Pupils present their prototype and receive oral feedback from the client(s) and their peers. Pupils participate in peer feedback exchanges.

Key guiding principles for design feedback

Our project was based on 3 key design principles that could help teachers in creating a setting within their design and technology classroom that encourages pupils to actively take part in the process of design feedback uptake, including providing support for both those who give *and* receive the feedback.

Principle 1: Design a learning environment which caters to and asks for active design feedback utilisation.

By creating a learning environment that allows for and caters to feedback utilization you can enable pupils to respond more positively to their design feedback. After all, feedback does not occur in a vacuum, and it likely does not initiate further action on its own. This can for example be done by making active feedback utilization an intrinsic part of a learning assignment. By planning multiple feedback moments in regular

intervals, conditions can be created in which feedback utilization becomes expected. For pupils this increases the need to take action and make their changes visible through the adjusted and improved design.

Principle 2: Implement high-quality peer feedback practices.

Secondly, the implementation of high-quality peer feedback is a promising way to improve feedback uptake. By learning how to give appropriate feedback, pupils increase their abilities in receiving feedback. When giving feedback to their peers, pupils will have to apply existing or self-created design criteria, diagnose problems in the designs and suggest creative solutions. It helps pupils' evaluative judgement by developing a sense of quality through comparisons with the work of others and reflecting on their own work. Furthermore, by learning how to construct appropriate feedback, i.e. valuable and constructive feedback, it will be of higher quality and thus easier to handle when received, thereby improving pupils emotional balance.

Principle 3: Provide explicit guidance, while enabling autonomy

Lastly, the use of explicit guidance is there to ensure that pupils are supported during all steps of the feedback process. Its use will lead the feedback receivers through the process of feedback uptake, from initially receiving feedback, making sense of the content, and deciding with which to continue, to actively using to spark their creative thinking and improve the design. Types of guidance are for example: the implementation of meta-dialogues on the value of design feedback to spark understanding and appreciation, the use of written feedback to help capture the key information and create a delay in receiving to support openness, and the use of verbal prompts to signal each step of the feedback process and make it explicit, while ensuring calmness. Creating distinct decision moments signals the importance of feedback

utilization. Additionally, making clear that not all feedback has to be used and that feedback can be rejected creates choice and autonomy. Maintaining some form of autonomy while keeping the guidance explicit supports pupils’ motivation.

Applying these principles to our project

Firstly, the design of the learning environment was created in such a way that giving, receiving, and utilizing design feedback had a central position throughout the design project. This structure intentionally created a learning environment that catered to, and actively asked for, pupils to use the feedback they had received. Secondly, an important component of the intervention was the implementation of high-quality peer feedback in design session 4 (intermediate design critiques) and 6 (final design critiques). Table 16.2 gives an overview of the peer feedback component of the intervention and the guidance that was given.

Table 16.2 Overview of the peer feedback component of the design feedback intervention

Preparation	Meta- dialogue, analysing examples and modelling exercises to teach the intention and the procedure to pupils. This was done mainly at the start of the intermediate design critiques in session 4, but pupils were also reminded at the start of the final design critiques.
The next steps are followed with each presentation during the design critiques	
Step 1 Guiding towards a shared	Pupil(s) present their design idea.
	Peers and clients receive verbal prompts to pose clarification

understanding	questions to work towards a shared understanding of the design. <i>‘What do you not yet understand about the design?’</i>
In the next steps the peers and clients receive scaffolding guidance by feedback forms (during intermediate design critiques) to construct written feedback OR verbal prompts (during final design critiques) to construct oral feedback	
Step 2 Emphasise positive aspects	Peers and clients are guided to construct specific compliments. <i>‘What do you think is already good about the design?’</i>
Step 3 Stimulating critical reflection and evaluation	Peers and clients are guided to construct convergent feedback. <i>‘We think this could be better about the design... because ...’</i>
Step 4 Providing a way forward	Peers and clients are guided to construct a divergent how-question. <i>‘How can you ...’</i>
	Peers and clients are guided to construct possible solutions to the uncovered shortcoming(s) (answering the how-question). <i>‘We think this could maybe be a solution ...’</i>

Figure 16.2 shows the template of the feedback form that was used as a scaffolding tool for written feedback. This template contained the guiding sentences that were used when teaching the pupils how to construct design feedback for their peers.

[Insert 03_Ch16_Fig16.2 here]

Figure 16.2 Template of the feedback form

Thirdly, the pupils received explicit guidance in design session 5 to help them with the process of receiving, discussing, selecting and utilizing the feedback forms they considered valuable for their creative design process.

Highlights from the project

Our analysis of the two case-studies demonstrated that different types of guidance can support pupils to engage in constructive and valuable peer feedback exchanges and encourage their feedback uptake. We found that generally, all pupils were able to use at least some of the received feedback to spark their creative thinking and consequently develop and improve their designs. Several successes were uncovered during the analysis, of which we will highlight a few next.

Stimulating cognitive modelling

Firstly, the peer feedback intervention stimulates pupils' cognitive modelling. When giving feedback to their peers, the pupils repeatedly showcased their cognitive modelling abilities in posing certain convergent feedback questions and comment. Through these types questions and comments the pupils imagined how the design of their peers would be used throughout time and constructed mental models of the design mechanisms and user interactions. A question could for example ask information about a future possible state of use. Cognitive modelling is seen a key component of designerly thinking and the peer feedback intervention supports pupils in expressing and practicing this.

Developing evaluative abilities

Secondly, the peer feedback intervention contributed to the pupil's evaluative abilities,

specifically the use of self-made evaluation criteria and the development of a sense of quality. As stated previously, the intervention did not give any specific guidance on how to evaluate and select the received feedback. Several of the pupils' self-made evaluation criteria can be linked back to the structure of the feedback forms. They for example not the importance of convergent feedback to uncover shortcomings in their design and divergent feedback to help them move forward. Additional criteria in evaluating the feedback were: completeness, clarity, objectivity, and a balance between compliments and critical feedback. All together, these evaluation criteria from an extensive list and show how pupils are able to create a good understanding of what compromises quality.

Taking an active role

Thirdly, the peer feedback intervention encouraged the pupils to take an active role within the feedback process, specifically through the explicit guidance by verbal prompts. Several studies have highlighted the passive and consumerist role pupils often take during unguided feedback processes. The rather strict level guidance of the peer feedback intervention made it more difficult for pupils to become passive. Nonetheless, active involvement from the pupils was still required for success. Therefore, it could be said that by merely following the guided procedure, a first step in active participation is reached. A next step would be that pupils engage in following steps of the process of feedback uptake without the need of specific guiding prompts. Here, it is important to note that the agency pupils need in taking such an active role might be more than they possess and should therefore be seen as a shared responsibility with the educators.

Points of concern

Although the peer feedback intervention initiated many successes, there are some things teachers need to be aware of when implemented something similar in their design and

technology classroom. Firstly, it is important to note that for the pupils receiving feedback it appears to matter who actually gives it. During the two case-studies, pupils showed more openness towards feedback from the clients than from their peers. This is for example because pupils can see their peers as less knowledgeable and put less value on their feedback because of that. Additionally, the peers generally construct feedback of lesser quality than the clients due to them still learning how to do so (see also next point). Secondly, the quality of the feedback influences the pupils emotional balance and thereby their openness to the feedback. High quality feedback, meaning constructive and valuable feedback, creates less resistance than lower quality feedback and is easier to handle for the pupils. Therefore, it can be useful to put certain quality checks in place when implementing peer feedback practices.

Although there are points of concern, this does not mean that peer feedback practices should not be implemented in the design and technology classrooms. Results from the research project demonstrated that pupils actually appear to get better in receiving feedback when learning how to construct it, as they develop an understanding for feedback quality through the peer feedback process. Evidence of this was an extensive list of self-constructed evaluation criteria. An example of a prominent evaluation criterium used by the pupils, was that feedback should uncover relevant and well explained shortcomings in their design, while also providing a ‘way forward’ through well-constructed how-questions and proposals. We presume that learning how to give divergent feedback enhanced pupils’ understanding on how this feedback is meant to help a designer within their creative process, thereby picking up on the underlying intention of ‘moving forward’. This is not necessarily a surprising outcome, but a treasured one, as it points towards the value peer feedback can have for the development of young novice designers’ evaluative judgement.

Conclusion

To conclude, guiding design feedback processes in the design and technology classroom can bring many benefits to pupils and support them in showcasing openness, developing a feel of quality, spark their creative thinking to develop their design into the 'best defensible compromise', taking an active role in the feedback processes, and many more. Short-term this helps enable pupils design feedback uptake and long-term it initiates the development of their design feedback literacy. The interplay of the key guidelines within the peer feedback intervention supports the pupils in achieving this and are solid first step towards valuable and constructive design feedback processes. Future endeavours to refine and expand these principles can provide valuable improvements to feedback processes in design education and are therefore encouraged.

Questions

1. What role do you think design feedback (or critiquing) should have within the design & technology classroom?
2. What type of design feedback is dominant within your classroom and what effect do you think this has on pupils' learning and progression?
3. How do you view the value of peer feedback within design and technology?
4. What other interventions could be done within the classroom to stimulate pupils' creativity while designing?

Co-Design with kids: Early mastering of 21st century skills

The tools used in the design sessions can be found on the following websites:

- www.tudelft.nl/codesignkids (English version)
- www.tudelft.nl/yourturn (Dutch version).
- Template of the feedback form (shown in figure 16.1) is available to download from www.tudelft.nl/codesignkids tool ‘Forward with feedback’

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