

# Enhancing Children's Creativity



**Building creative confidence through design education at primary schools**

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# PREFACE

Creativity has always fascinated me. I was lucky to grow up in a creative family, where imagination and problem-solving were simply part of everyday life. Throughout my studies, I have been drawn to understanding how creativity works, how we perceive ourselves as creative (or not), and what helps us build creative confidence.

It surprises me sometimes when people insist they're not creative. I often wish I could gently shake them and say, *"You are so creative - even if you don't see it yourself!"* One of my friends once called me a creativity motivational speaker, which still makes me laugh, but that mindset might have shaped the way I approached this project. I believe that every child is born creative, with the potential to imagine, explore, and express ideas in their own way. Helping them strengthen that belief in themselves felt like a meaningful goal to pursue in my final graduation project, marking the end of my time studying in Delft.

I would like to express my gratitude to everyone who contributed to this project.

First of all, to **all the teachers** who opened their classrooms to me, shared their perspectives, and welcomed my workshops with such enthusiasm - thank you for your openness and trust.

To **all the children** who participated: you made this project come alive with your ideas, your laughter, and your endless energy. Watching your creative minds at work was one of the best parts of this journey.

I would also like to thank **my supervisors, Mathieu and Milene**, for their guidance, encouragement, and insightful feedback throughout the process. You challenged me to look at things differently and helped me bring the best out of the project.

To **my parents and my sister**, thank you for your endless support, for reminding me to take breaks, and for always being there when I needed it.

And finally, to **my friends & thesis buddies**, thank you for celebrating both the small and the big wins with me, and for your constant encouragement throughout this journey.

I am very excited to share this project with you. I hope you enjoy reading it as much as I enjoyed creating it.

- Sarah

# EXECUTIVE SUMMARY

This project aims to support and enhance the development of creativity in children, with a particular focus on strengthening their creative confidence and creative thinking during the idea generation phase of the design process. Responding to the growing emphasis on 21st century skills, this report builds on the Your Turn materials developed by the Science Hub TU Delft, to foster these abilities through design education.

A literature review established a theoretical foundation using the 5A's of Creativity framework, while contextual exploration through interviews with primary school teachers (n=6) and education professionals (n=3) identified key barriers to creative engagement, including low creative confidence, fear of failure, and limited teacher support. These insights shaped the central design question: How can children and teachers shift their focus from outcomes to the creative process itself?

Guided by a Research through Design approach, the study involved a exploratory workshop and 'creative confidence' workshops (n=32 total participants) and design lessons with 85 children (group 5-8) across four schools. Insights from these activities informed the development of five design tools: Draai door, Ideeënbord, Spontane verhalen, Ideeën estafette, and Mindful musical, alongside two teacher support artefacts: the 'Guide to Sparking Creativity' and a poster.

Evaluation interviews with teachers (n=5) indicated that the tools successfully stimulated creative thinking and confidence in children, while the support materials were valued for their clarity and usability. Recommendations include continued testing across more diverse school contexts to refine their integration into everyday teaching practice.



# GLOSSARY

To support clarity and consistency, this glossary explains important terms used throughout the report.

**Creative confidence:** A person's belief in their ability to think and act creatively.

**Group, e.g. group 7:** This term refers to the Dutch word '*groep*', which is used to indicate a specific year in primary education (see table).

**OOL or O&O (Onderzoekend en Ontwerpend leren):** Translates to 'Inquiry- and design-based learning'. It is a didactic way of learning created by SLO, in which students ask their own questions, conduct research and/or design solutions to real problems. It aligns with science and technology education and promotes 21st-century skills.

**SLO (Stichting Leerplan ontwikkeling):** Translates to 'Institute for Curriculum Development'. SLO is the national institute in the Netherlands responsible for curriculum development in primary, secondary, and special education. It provides frameworks, guidelines, and support for schools and educators, focusing on the development of coherent and future-proof curricula aligned with national education goals.

**Primary education:** In this report, primary education refers to the Dutch 'Primair onderwijs', which focuses on teaching 4- to 12-year-olds. For more information see table below.

**Wetenschapsknooppunt TU Delft (Science Hub):** Also known in English as the 'Science Hub TU Delft', is part of a Dutch national network of universities that supports primary schools and teacher training programs in inquiry- and design-based learning (OOL). TU Delft staff, researchers, and designers collaborate with primary school teachers on projects that focus on the design process, aiming to stimulate creative thinking, designing, and researching in both pupils (aged 4-12) and teachers.

## Dutch education system

In short, primary school in the Dutch education system starts at age of 4 (group 1) and from the age of 6 (group 3) children start officially with learning to write and read.

<b>Focus of this project:</b>	Group	Group 5	Group 6	Group 7	Group 8
	Age	8-9	9-10	10-11	11-12

# READING GUIDE

This guide will help you follow the project's path, from early research to the final concept, whether you're reading everything or just browsing through.

*If you want to know more about...*

- ... the relevance of the project: **Chapter 1**
- ... the activities and methods used in the project: **Chapter 2**
- ... the theoretical background on creativity: **Chapter 3**
- ... current materials in the Your Turn toolkit: **Chapter 4.1**
- ... teachers' influences: **Chapters 4.2 & Chapter 6.4**
- ... the main problems with supporting creativity: **Chapter 5**
- ... the sessions with children: **Chapter 6**
- ... the key insights that shaped the final designs: **Chapter 7**
- ... the process of creating the designs: **Chapter 8**
- ... the final designs: **Chapter 9**
- ... how teachers evaluated the final designs: **Chapter 10**

Throughout the report, several icons are used to draw attention to important information or key insights.

**Chapter 7** explains in more detail what they mean and how they are used in the design process.



This icon is different, as it refers to research or publications by, or connected to, Your Turn and the Science Hub, offering their perspective on various topics.



Design requirements



Design conditions



Inspiration sparks

# CONTENT

<b>1 introduction</b>	<b>8</b>	<b>7 refining the design challenge</b>	<b>70</b>
1.1 project relevance	9	7.1 looking back and moving forward	71
1.2 project context	11	7.2 design requirements and conditions	72
1.3 project aim & research questions	13		
<b>2 project approach</b>	<b>14</b>	<b>8 shaping new ideas</b>	<b>74</b>
2.1 introduction	15	8.1 idea generation for design tools	75
2.2 research phase	17	8.2 idea generation for teacher support	81
2.3 development phase	19		
2.4 participants & recruitment strategy	21	<b>9 final designs</b>	<b>84</b>
		9.1 how the designs work together	85
<b>3 literature research</b>	<b>23</b>	9.2 final supporting artifacts	86
3.1 introduction	24	9.3 final design tools	89
3.2 artifact	26		
3.3 actor	26	<b>10 evaluating</b>	<b>93</b>
3.4 audience	30	10.1 evaluation framework	94
3.5 action	31	10.2 evaluation of the supporting artifacts	94
3.6 affordances	33	10.3 evaluation of the design tools	95
3.7 conclusion	35	10.4 evaluations by others	97
		10.5 design recommendations	99
<b>4 context research</b>	<b>36</b>	<b>11 conclusion</b>	<b>100</b>
4.1 current your turn materials	37	11.1 conclusion	101
4.2 teacher context interviews	40	11.2 limitations	102
4.3 science hub context interviews	42	11.3 future research	103
4.4 conclusion	43	11.4 personal reflection	104
		<b>12 references</b>	<b>105</b>
<b>5 defining the problem</b>	<b>44</b>	<b>13 appendix</b>	<b>109</b>
5.1 introduction	45		
5.2 problem framing	45		
5.3 reflecting with creative facilitation experts	47		
5.4 design focus	49		
<b>6 sessions at schools</b>	<b>51</b>		
6.1 introduction	52		
6.2 idea generation and initial concepts	55		
6.3 creative confidence workshop	58		
6.4 design lessons at schools	63		
6.5 conclusion	69		



# introduction

1.1 project relevance

1.2 project context

1.3 project aim & research questions

Chapter 1 explores the relevance, context, and overarching aim of the project, while also outlining the key research questions that guide the research phase.

# 1.1 Project relevance

## 1.1.1 Need for 21st century skills

Children today are growing up in a rapidly changing world, where new technology and innovations are transforming the world around them from an early age. To keep up with these changes, both how and what children learn in primary education may also need to evolve. In 2019, SLO (Stichting Leerplan Ontwikkeling), the Dutch national expertise centre for curriculum development in the Netherlands, published a list of the most essential skills for children to have. These skills are known as the 21st century skills (SLO, 2019) and are based on global educational policy reports and skill development frameworks.

A couple of years earlier, an introduction to the 21st century skills was published by SLO on behalf of the Dutch Ministry of Education, Culture, and Science, as a response to ongoing debates about the future of education (Thijs et.al., 2014). In this, SLO outlines a vision of how education needs to develop in the coming years to prepare students for the future, by pointing out several major developments that are reshaping society and the future labour market.

Firstly, they highlight the rise of technologization and informatization, which moves our focus from industrial production to knowledge creation and innovation. As routine and manual jobs continue to decline, there is a growing demand for people who can adapt, solve problems, think creatively, and collaborate effectively. At the same time, media and digitalization are deeply influencing everyday life, in the way we communicate and access information.

Another important change is globalization, which makes it easier for people and businesses to communicate and work together across countries. Since economies and problems are more connected than ever, people need to be ready to join international networks and work with others from different cultures.

Lastly, rising individualization means that young people today have greater freedom, but also more responsibility, to shape their own life paths. This shift requires self-awareness, decision-making skills, and a sense of personal responsibility to navigate complex choices.

Altogether, the key question of what children and youth need to learn in today's world led to the framework of 21st century skills in figure 1.



Figure 1. Overview of the 21st century skills (Sol & Visser, 2023)

## 1.1.2 Recent repositioning of the 21st century skills

Recently, SLO has been (and still is) looking into new skills to substitute the 21st century skills due to criticism on the concept. A common criticism is that the 21st century skills rely too much on economic thinking and wrongly suggest the skills are 'new' even though they have been relevant for a long time. Critics also argue that some skills must be learned within specific subjects and that the definitions of the skills are unclear, often mixing skills with knowledge, attitudes, and even personality traits, making them hard to teach or assess (Sol & Visser, 2023).

For these reasons, a new way of categorizing the skills is created. The 'skills' are defined as follows: "A skill is an ability to solve problems or perform tasks adequately by thinking and acting on the basis of certain knowledge" (Sol & Visser, 2023, p. 10).

A notable addition is the skills combining various knowledge components and sub-skills, which explicitly mention design as a core element, which was not previously incorporated in the 21st century skills. Creative thinking, which will later be explained as one of the most important skills, is also highlighted in the category of thinking skills.

The old and new categorization is shown in figure 2.



Figure 2. Repositioning of 21st century skills, Adapted from SLO (2025)

## 1.2 Project context

### 1.2.1. Teaching 21st century skills through design

One way to teach children 21st century skills is by teaching them design, not only as a fun activity, but as a designerly way of thinking that helps them approach complex challenges. As mentioned before, in today's rapidly changing world, children need more than just factual knowledge; they need adaptable thinking strategies. Although this may seem complex for primary school children, research has shown that they can actively participate in the core processes of creative problem solving (CPS), such as understanding a challenge, generating ideas, preparing for action, and planning their approach (Hooijdonk et al., 2023).

This supports the idea that children are capable of participating in design-like thinking, through which they develop skills in creativity, problem-solving, communication, and teamwork (Kokkinaki & Georgiadou, 2024), which are all part of the 21st century skills children need, according to SLO (2019).

Design activities allow for openness, which gives children the freedom to explore, experiment, and think creatively. Lewis (2006) explains that by design being open-ended, there is not one strict right answer or right method to follow. This helps children move away from conventional thinking and challenges them to think in multiple directions.

### 1.2.2. Creativity at the heart of design

Within the 21st century skills framework, creativity is widely recognized as one of the most important skills to have (Calavia et al., 2023; Valqueresma et al., 2022) and lays the foundation of both doing and learning to design. Buchanan (1992) describes design as inherently creative, as it involves addressing ill-defined, open-ended challenges that require reframing problems and generating original solutions. Through design, children are encouraged to think in all directions, take risks, and approach problems from multiple perspectives, which will help them grow creatively.

The ability to think creatively and do creative tasks is influenced by the creative self-beliefs people hold about themselves. In short, creative self-beliefs refer to how people perceive their own creativity. These creative self-beliefs play an important role in shaping motivation and engagement in creative tasks. This project will focus on a specific category of creative self-beliefs, namely: creative confidence, which is the belief in one's ability to act creatively (Beghetto & Karwowski, 2023). Focusing on creative confidence is especially relevant for children, as this self-belief is future-oriented and highly adaptable. This means it can be developed over time, supporting children's creative growth both in the present and as they continue to grow older. Research has found that this creative confidence can be enhanced by engaging in creative tasks, as Atwood-Blaine et al. (2019) showed when children's confidence significantly increased after participating in creative activities. The participation in and the guidance of such creative activities will therefore be the core of this thesis, as they provide a concrete way to foster children's creative confidence and will be further investigated in Chapter 3.3.



### 1.2.3. Teaching design with 'Your Turn'

The Wetenschapsknooppunt TU Delft (Science Hub) is a significant contributor to the development of design-based learning materials for primary schools. They are a team of educational specialists, designers, and researchers who conduct research on how design thinking and research-based learning (OOL, see glossary) can be incorporated into primary education (Wetenschapsknooppunt TU Delft, n.d.). Their focus is on developing practical interventions and methods that can be directly applied in classrooms. Inspired by how designers at the faculty of Industrial Design Engineering approach problem-solving, the Science Hub aims to teach children the same skills designers have. Their goal with this is to foster creativity, communication, and collaboration in pupils by engaging them in the design process.

In close collaboration with teachers and researchers, they developed 'Your Turn: make your mark in design'. The Your Turn approach introduces a series of design tools (in Dutch: 'werkvormen') for children aged 9-12 in primary schools, with extra attention to creativity, empathy, and effective communication about design solutions. In addition to the design tools, there are multiple lesson series and projects for all levels in primary schools (Klapwijk et al., 2021).

Your Turn uses the design cycle, shown in figure 3. A design cycle visualizes the design process by dividing it into smaller steps. In the Your Turn materials, there are different design tools for each phase in the design cycle.

The Wetenschapsknooppunt and the Faculty of Industrial Design Engineering (IDE) are looking to expand the existing Your Turn toolkit. In doing so, they have linked their individual concerns into a shared vision, which resonates with the principle of reciprocal value in design described in the Delft Design Guide (Van Boeijen et al., 2020). This principle emphasizes that co-design should benefit both designers and participants, in this context, by enabling children to develop design skills through participation while also providing designers with tools that support more effective co-design. The expansion of the Your Turn toolkit focuses on the 'generating and selecting ideas' phase of the design process, particularly in idea generation.

This is aimed at both adding to the current materials and creating tools to assist designers in doing co-design projects with children. The development of new materials is grounded in a desire to recognize and support the full potential of children's creativity in design contexts, by deepening the understanding of how creativity manifests and how it can be meaningfully supported.

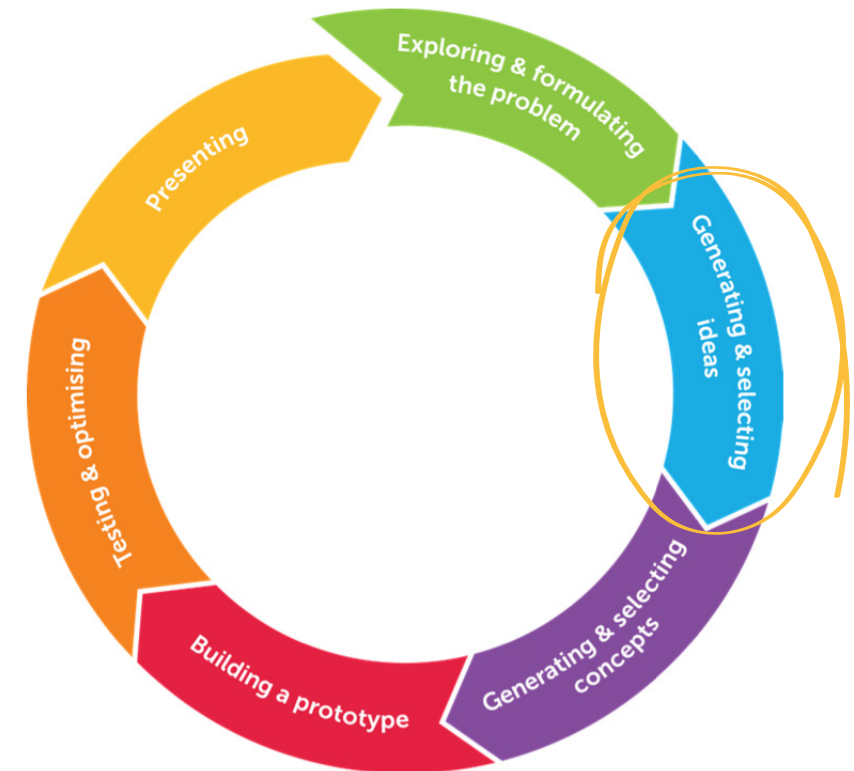


Figure 3. Design cycle used in the Your Turn materials (Klapwijk et al., 2021)



## 1.3 Project aim & research questions

### 1.3.1. Project aim

This project aims to support and strengthen the development of creativity in children, with a particular focus on building their creative confidence during the idea generation phase of the design process. Responding to the growing need for 21st century skills, such as adaptability, problem-solving, and creative thinking, this project builds on the existing Your Turn materials developed by the Wetenschapsknooppunt TU Delft. It seeks to expand this toolkit by developing new, research-informed methods and resources that empower children to engage more confidently and effectively in creative thinking.

The expansion is also intended to support designers and educators by providing tools to assist in co-design projects with children. By helping children believe in and practice their own creative abilities, this project aims not only to support their current learning today but also to lay the foundation for essential lifelong skills to navigate an increasingly complex and fast-changing world.

The first chapters of this report will explore how creativity is currently supported and how it could be better supported, by reviewing relevant literature and examining the educational context. Based on these insights, a design challenge will be formulated to guide the development of a design intervention tailored to the context described above.

### 1.3.2. Research questions

The research question guiding this first phase is as follows:

**“How is creativity supported during the idea generation phase among primary school children aged 9 to 12?”**

To break this question down, the following sub-questions will be looked into:

1. How is creativity defined?
2. How do cognitive processes, such as divergent and convergent thinking, support creativity in children?
3. How do creative self-beliefs affect creativity in children?
4. What are enablers and obstacles to training problem-solving-oriented creativity in children within the context of the classroom?

# 2

## project approach

- 2.1 introduction
- 2.2 research phase
- 2.3 development phase
- 2.4 participants and recruitment strategy

In this chapter, the project approach is outlined which follows two different phases: the research phase and the development phase. Each phase is explained through the activities done and how stakeholders and experts are involved.

## 2.1 Introduction

This graduation project is structured around a research phase and a development phase, with active involvement of stakeholders and experts throughout. The research phase combines insights from theory and practice to build an understanding of the core problems. Building on this foundation, the development phase focuses on generating and refining design solutions that directly address the design question.

### 2.1.1 Overview of all activities

To illustrate all the activities done throughout the project, the timeline on the next page (figure 4) presents the chronological order, the number of activities, and the number of participants in the activities. Each coloured block represents one activity with one participant, unless stated otherwise.

The chronological view highlights how later activities were informed by earlier ones, for instance, ideas from the creative facilitation experts session were used in the workshops, and workshop concepts shaped the lessons.

Figure 5 complements this by showing how each activity relates to the core questions explored. As introduced in Chapter 1, the research process is led by the research question and its sub-questions. Next to the research question, a design question based on the early research findings is introduced to guide further exploration and the final designs.

With both figures, the colour **blue** represents activities in the research phase and **pink** in the development phase. The colour **purple** represents Research through Design activities, that both touch upon gaining insights for research and initial ideas for the development phase.

## Research phase

Literature review

Teacher interviews

Science Hub interviews

Creative facilitation experts session

n=4  
Number of participants

Corresponds to 'School 3' in figure 3

Workshop with kids 1

S3 S3 n=4 for each workshop

Workshop with kids 2

S1 S1 S2 S2 S3 S3 n=4 for each workshop

Lesson set-up evaluation

Lesson with teachers and kids

S1, n=25 S2, n=24 S3, n=21 S4, n=15

Design review with Science Hub

n=3

Final design evaluation with teachers

Design review with creative facilitation experts

\*Design evaluation with design students

## Development phase

Figure 4. Overview activities in timeline

## Research

How is creativity supported during the idea generation phase among primary school children aged 9 to 12?

How is creativity defined?

How do cognitive processes, such as divergent and convergent thinking, support creativity in children?

How do creative self-beliefs affect creativity in children?

What are enablers and obstacles to training problem-solving-oriented creativity in children within the context of the classroom?

Literature review

Teacher interviews

Specifically, how the teachers and schools define creativity

Teacher interviews

Science Hub interviews

Creative facilitation experts session

Workshop with kids 1 & 2

Lesson with teachers and kids

## Development

How might we help children aged 9 to 12 shift their focus from the end result to the creative process, in order to foster creative confidence, while also supporting teachers in understanding and facilitating this shift?

... help 9-12 year old children...

... supporting teachers...

Lesson set-up evaluation with teacher

Design reviews and evaluations

Figure 5. Activities linked to the research and design question

## 2.2 Research phase

The first phase in the process involves exploring the context and existing literature to answer the research question. The activities are done to build a theoretical foundation about creativity and gain insight into how creativity is supported in classrooms from multiple perspectives. The goal here is to ground the project in relevant theory and to uncover real-world insights from practice.

### 2.2.1 Literature research

A literature review was chosen as a well-suited starting point for the project because it allowed for the systematic gathering and structuring of existing knowledge. The process of collecting literature was exploratory and developed iteratively, guided by ongoing conversations with various stakeholders and emerging insights along the way. Initial searches included broad terms like Creativity and children, Creative confidence, Creative processes, Ideation and Education. As key themes started to take shape, such as the framework of defining creativity, more focused directions followed.

The aim was to gain a clearer understanding of how creativity can be defined, what its key components are, and how it manifests in the context of primary education. This process, guided by the main research question and its sub-questions, helped to construct a theoretical lens through which opportunities and challenges in fostering creativity in schools could be identified.

### 2.2.2 Context research

While the previous chapter addressed the research question from a theoretical perspective through a literature review, this chapter turns to the practical context by examining current materials and conducting interviews with multiple experts and teachers. The aim is to investigate the research question from a real-life perspective, building an understanding of how creativity is currently supported in schools. Firstly, the current Your Turn materials are examined, specifically the idea generation methods and teacher support resources for creativity.

Investigating current materials helped to create a starting point before proposing extensions, by analysing the strengths and limitations, identifying gaps, and ensuring coherence when proposing additions to the Your Turn toolkit.

Next to reviewing current materials, several context interviews were conducted. Interviews were chosen because they offer direct insights into real-life experiences and individual perspectives. The overall aim of these interviews was to gain a more nuanced understanding of classroom dynamics and the broader school environment.

Firstly, six semi-structured interviews were conducted with primary school teachers (groups 5–8) to understand how creativity is approached in everyday educational practice. These interviews explored how teachers currently define and encourage creativity, what challenges they face, and how their schools support creativity through educational materials. All of the teachers interviewed work at traditional Dutch schools and had limited to no experience with doing design projects, except for one teacher from school 5 (See table in section 2.4).

The broader context of design education at primary schools was investigated through three informal interviews with people connected to the Science Hub TU Delft. They all have extensive experience with creating educational materials, mostly in a design context. The goal for these interviews was to better understand the bigger picture of design in primary education and how schools and outside organisations work together to support creativity in the classroom. In addition, they aimed to provide insight into the background of Your Turn and explore possibilities for expanding the current materials. The interviewees' knowledge and experience stem from working closely with schools, hands-on guiding children through the design process, and supporting teachers, while also staying informed by academic and educational policy developments.

### 2.2.3 Defining the problem

The research findings were first analysed through a problem-framing lens to identify the key challenges that guide the Research through Design process. Using the 5 A's of creativity framework as a structure, the data from theory and practice were mapped, compared, and reorganized to surface recurring themes and tensions. This process revealed three central problems, which highlight the gap between literature and classroom practice. To validate this framing, the identified problems were further reflected on with creative facilitation experts from TU Delft.

### 2.2.4 Creative facilitating experts session

To validate the problem statements derived from the initial findings, a workshop was conducted with four creativity experts from TU Delft. The session combined elements of focus groups, co-creation, and design to translate real-life experiences into actionable problem directions and initial solution ideas. These experts were involved because of their experience in observing and supporting creative processes, which made them particularly well-suited to reflect on ways of enhancing and supporting creativity in education.

Experts were invited to share their own experiences with supporting creativity, specifically in relation to sub-questions 3 and 4: How do creative self-beliefs affect creativity in children, and what are the enablers and obstacles to training problem-solving-oriented creativity in children within the classroom context? The main purpose was to see whether the experiences and problems identified by the experts in their work as facilitators were similar to those identified in the earlier research.

After validating the key problems, they were reformulated into a guiding design question to sharpen the design focus. Establishing this question provided the necessary guidance to move from abstract problem framing toward the concrete creation of materials for the design process.

### 2.2.5 Research through Design

With the design challenge in place, the project transitions into the ideation phase. This phase emphasized iterative development and active participation of stakeholders. The process took inspiration from the Research through design methodology (RtD). As explained by Stappers & Giaccardi (2014), RtD can be defined as follows:

[Research through Design refers to] **design activities** that play a formative role in **the generation of knowledge**, typically actions that we'd recognize as design activities from one of the design professions, that depend on the professional skills of designers such as gaining actionable **understanding of a complex situation**, **framing and reframing** it, and **iteratively developing prototypes** that address it. (Stappers & Giaccardi, 2014, section 41.1.4)

This approach made it possible to gain a deeper understanding of the classroom context and children's creativity. Multiple workshops and lessons were done to fully immerse in the real-life context, explained below. Children were central participants in this part to actively involve them in the creative process, observe their engagement firsthand, and understand how they express and develop ideas in practice.

The starting activity was an initial workshop to explore how children engaged with design tasks and methods, while also piloting practical aspects such as materials and timing. This was followed by workshops aimed at examining how creative confidence develops through engagement with different design tasks. The designs used in these workshops were derived from the previously mentioned session with creative facilitation experts, who conducted a brainstorming session to generate ideas addressing the challenges they had identified. These

ideas functioned as a starting point for short ideation, resulting in three concepts that were implemented in the workshop.

Finally, design lessons were implemented to evaluate whether the set-up and methods encouraged students to value the creative process over final outcomes, to analyse how teachers actively support creativity, and to gather broader insights into how creativity is facilitated. All sessions were guided by the overarching design question, while also generating insights that contribute to the broader research question.

An overview of the number of sessions, participants and corresponding schools can be found in 2.1.1, with details on the schools provided in 2.4. Insights from the activities at schools led to insights for idea development and also a first concept idea to further explore in the development phase.

## 2.3 Development phase

The development phase of this project was structured as an iterative process in which design concepts were generated, refined, and evaluated in close dialogue with experts and practitioners. The overall aim was to define the design requirements, translate these into concrete tools and artifacts guided by the design questions. The methodology was intentionally staged to allow for exploration, expert feedback, and alignment with the realities of classroom practice.

### 2.3.1 Refining the design challenge

The refinement of the design challenge looked back on the outcomes of the previous defined design challenge and the new Research through Design explorations. This phase focused on translating the research insights into design requirements, identifying broader design conditions, and collecting inspiration sparks. This step was necessary to consolidate the findings into a structured foundation for idea development.

### 2.3.2 Idea generation and concept development

The first step focused on producing a range of ideas for tools that could help children value the creative process. Through brainstorming structured around the previously identified 'sparks' of inspiration, ensuring that new directions were rooted in the design requirements. The use of a Harris Profile (Van Boeijen et al., 2020) inspired evaluation method allowed for systematic comparison of the initial ideas against the design requirements and the inspiration sparks, ensuring that the selection process was both transparent and criteria driven. This method was chosen because it prevented intuitive but potentially biased choices and instead supported a balanced prioritization of feasibility, uniqueness, and relevance.

Next, the initial ideas were refined by merging and adapting them. The goal was to arrive at a set of concepts that fit the requirements and could each embody specific sparks.

### 2.3.3 Expert review of concept tools

To validate the concept designs and to avoid developing concepts in isolation, the preliminary ideas were reviewed by three project leaders from the Science Hub. The aim was to reflect on the design tools with practitioners who have extensive experience working with children in design contexts. This provided early insights into feasibility and contextual fit, which helped prevent later misalignment.

### 2.3.4 Teacher support artifacts

In parallel with the development of tools for children, supporting artifacts were created for teachers. The reason for this step was that the effectiveness of process-oriented creativity in classrooms depends not only on child-facing tools but also on teachers' ability to recognize and foster the underlying conditions.

The chosen formats, a concise booklet and a complementary poster, and the content of the artifacts were deliberately selected to align with teachers' working realities, informed by the findings in the research phase.

### 2.3.5 Expert review of teacher artifacts

To validate the teacher-facing artifacts, they were reviewed by creative facilitation experts from TU Delft. This step was methodologically relevant because it allowed for cross-checking the clarity and accuracy of the materials against established facilitation practices. The review questions focused on alignment with practice and comprehensibility for non-experts. This ensured that feedback addressed both theoretical soundness and practical usability.

### 2.3.6 Final designs and teacher evaluation

The development phase concluded with the proposal of five design tools and two supporting artifacts, a booklet and a poster.

To assess their potential effectiveness and practicality, a structured evaluation was carried out with five primary school teachers (groups 5–8). Two of these teachers had prior experience with O&O education (Research and Design), while the others were less familiar with this approach, which provided a mix of experienced and fresh perspectives.

A semi-structured interview format was used, allowing space for discussion while maintaining a clear and comparable structure. Each teacher was first introduced to the supporting artifacts (the poster and booklet) and asked to share their impressions. The five design tools and their accompanying worksheets were then discussed one by one, focusing on their clarity, applicability in the classroom, and potential to support creative thinking.

Because of time constraints within the project, classroom testing with students was not included in the main evaluation. However, one participating teacher chose to test the tool Mindful Musical in her own class and shared her experience afterward.

In addition, the tools were presented to master's students of the Child and Play Perspectives course at the Faculty of Industrial Design Engineering. Two student groups used several tools in co-design sessions with children, and their reflections were included to enrich the evaluation with additional, practice-based perspectives.



## 2.4 Participants and recruitment strategy

Participants were recruited through personal networks, focusing on covering the full 9-12 age range. This resulted in 4 different participating schools with a group 5, 6/7, 7 and 8. The schools that specifically participated in the sessions were chosen not only to cover the age range but also to provide a varied mix of experience with idea generation, class cultures, and types of education within the Dutch school system. The creativity experts were found through networks connected to the IDE faculty at TU Delft.

### *In total, the project involved:*

- 6 teachers (Context interviews in research phase)
- 3 people from Science Hub (Interviews & Design review)
- 4 creative facilitation experts (Creative workshop & Design review)
- 32 children (Workshops 1 and 2)
- 85 children and 4 teachers (Design lesson)
- 5 teachers (Evaluation interviews in development phase)

### 2.4.1 Participating schools

Since the participating schools differed significantly in character, multiple factors likely influenced the dynamics and outcomes of the sessions. A number of key contextual characteristics of the four participating schools and classes are summarized in the figure 6 at the end of this section. Each column represents a different aspect that was found to influence how students engaged with the idea generation activities, which will be shortly explained below.

#### **School**

This column lists the participating schools, labelled numerically (e.g., School 1, School 2, etc.) to maintain keep the schools autonomous, while allowing comparison across cases.

#### **Type of education**

This column describes the educational orientation of each school, such as whether it follows a traditional or project-based curriculum. This classification helps situate the learning environment and teaching approach, but also the experience of kids with broader (design) projects.

#### **Classroom culture**

Based on observations during the sessions, classroom culture was evaluated along three dimensions.

**Structure in teaching:** The degree to which the classroom followed a strict (rule-bound, teacher-directed) or flexible (student-directed, open-ended) teaching style.

**Task focus:** The level of attentiveness and task-oriented behaviour during the session, ranging from chaotic to focused.

**Peer interaction:** Whether students worked (and were used to working) individually or in a collaborative manner.

These three components together provide a nuanced picture of how each classroom environment functioned during the creative process. These insights were drawn from observations during the sessions, discussions with teachers before and after the activities, and cross-school comparisons, allowing identification of factors that shaped children's engagement and attitudes.

#### **Experience with ideation**

While none of the participating classes had previous experience with the design process as introduced earlier on, they did differ in their general familiarity with idea generation. Based on classroom practices and teacher interviews, the ideation experience was categorized into three levels, shown on the next page.

**Limited experience:** Students primarily engage in structured arts and crafts activities with very little freedom; tasks often involve following instructions closely and expanded to choosing your own colours within a pre-defined artwork.

**Some experience:** Students occasionally participate in larger or more open-ended projects where they can choose their own topics. Brainstorming is sometimes used, but students have limited familiarity with other idea generation strategies.

**Rich experience:** Students regularly conduct independent projects across subjects and are familiar with a wide range of idea generation tools and methods. They are comfortable expressing, developing, and sharing their ideas in different formats.

These classifications provide a contextual foundation for analysing how students approached and participated in the idea generation sessions across the different school settings.

Quick overview of each school

**School 1** had a strict teaching structure but was chaotic during activities, with students tending to work individually rather than interact. Despite clear rules, the class lacked focus during the creative task.

**School 2** also followed a strict structure but was more focused and orderly. However, like School 1, students worked mostly individually, showing limited peer engagement.

**School 3** differed in having a more flexible teaching approach, paired with a focused classroom environment. Students were collaborative, readily engaging in teamwork and sharing ideas.

**School 4**, similar to School 1, was strict in structure but experienced chaotic classroom dynamics and individualistic work styles during the sessions.

**School 5** is included in the table because, during the context interview, it offered the added perspective of a school with extensive experience in idea generation for projects, providing a valuable contrast to the other schools.

2.4.2 Ethical considerations

Conducting research with human participants, especially children required careful attention to ethical guidelines. The project received approval from the Human Research Ethics Committee (HREC) at TU Delft. All adult participants were informed about the project content and involved risk, and they signed informed consent forms.

As the children in the target age group for this project are below the age of legally giving consent, informed consent was obtained from parents. This was done through schools, using take-home forms that were signed and returned by the parents. All data was handled with care: anonymized during processing, stored securely, and used exclusively for research and design purposes.

School code	Group	Type of education	Class culture	Idea generating experience
School 1	Group 6/7	Traditional subject-based teaching	Strict structure, chaotic energy, individual tasks	Limited experience
School 2	Group 5	Traditional subject-based teaching	Strict structure, task focused, individual tasks	Limited experience
School 3	Group 8	Thematic teaching	Flexible structure, task focused, collaborative tasks	Some experience
School 4	Group 7	Traditional subject-based teaching	Strict structure, chaotic energy, individual tasks	Some experience
School 5	-	IB PYP (International Baccalaureate school, Primary Years Programme)	-	Rich experience

Figure 6. Characteristics of participating schools

# 3

## literature research

- 3.1 introduction
- 3.2 artifact
- 3.3 actor
- 3.4 audience
- 3.5 action
- 3.6 affordances
- 3.7 conclusion

Chapter 3 dives into literature to explore how creativity is defined and understood across different contexts, in order to build a theoretical foundation for examining how creativity is supported among children.



# 3.1 Introduction

This literature review will explore how creativity is defined, what its key components are, and how it shows up in the context of primary education. The aim is to build a strong foundation for understanding both the potential and the challenges of supporting creativity in schools.

To start, **how can we define creativity?** The word ‘creativity’ often means different things to different people. For some, it’s about artistic expression, like being good at drawing or crafts. For others, it’s imagination or problem-solving. In academic literature, there are also many ways of defining or analysing creativity, which shows that it is a complex and multifaceted concept. When you take a step back and look at creativity from a broader perspective, it becomes possible to look at it through different lenses that highlight different aspects of what creativity is and how it works. The following section introduces some of these frameworks and outlines the one used to guide this literature review.

## 3.1.1 Grasping creativity

In 1961, Rhodes introduced the 4 P’s model, which had a great impact on how to define creativity and is still relevant to this day. The 4 P’s model considers creativity through four dimensions: Person (the individual), Process (cognitive and emotional operations), Product (the outcome), and Press (the environment) (Rhodes, 1961). While the 4 P’s model offers a valuable framework for understanding creativity, Glăveanu (2013) argues that it overlooks the dynamic and social side of creativity. He proposed the 5 A’s framework: **Artifact**, **Actor**, **Audience**, **Action** and **Affordances**.

This way of looking at creativity is chosen to guide this thesis, as it is especially useful in the context of education, because it allows to investigate the different parts of the learning environment, like the teachers, peers, tools, or the classroom and how they all influence each other.

Since the 5 A’s emphasize the broader context in which creativity unfolds, it’s both relevant and insightful to explore what each of the A’s might look like within this project. To define this, the framework is interpreted through the lens of children ideating in an educational setting. The original meaning of each ‘A’ as defined by Glăveanu (2013), a simplified explanation of that ‘A’, and the ‘A’ placed in this context is visualized in figure 7.

5 A’s	Original meaning (Glăveanu, 2013)	In simpler terms	Meaning within context
Artifact	Cultural object embodying meaning, shaped by cultural traditions	Created thing or idea, shaped by culture	Creative outcomes like sketches, ideas, or design concepts created by the child
Actor	Person embedded in field of social relations and cultural traditions	Person creating within social and cultural world	Child (age 9-12) engaged in idea generation and people who influence the creation
Audience	Multiple others who evaluate, contribute to, and engage with creation	Others who engage with and evaluate the creation	The role of teachers, peers and parents as social influences
Action	Coordinated psychological and behavioural manifestation situated in context	Doing and thinking involved in creating something	Creative process in doing idea generation
Affordances	Cultural, material, and social conditions enabling creativity	What the environment allows or offers to do	Provided (design) material and classroom environment

Figure 7. Meaning of the 5 A’s of creativity

Even though the 5 A's may look like separate elements, Glăveanu (2013) stresses that all A's are interrelated and **the interaction and relations between the A's make for creativity to happen**. Figure 8 below shows how creative Action happens through the relationship between the Actor and the Audience. This relationship leads to the creation and use of new Artifacts, within a specific physical, social, and cultural setting. This setting, and its Affordances, also changes over time because of the creative action.

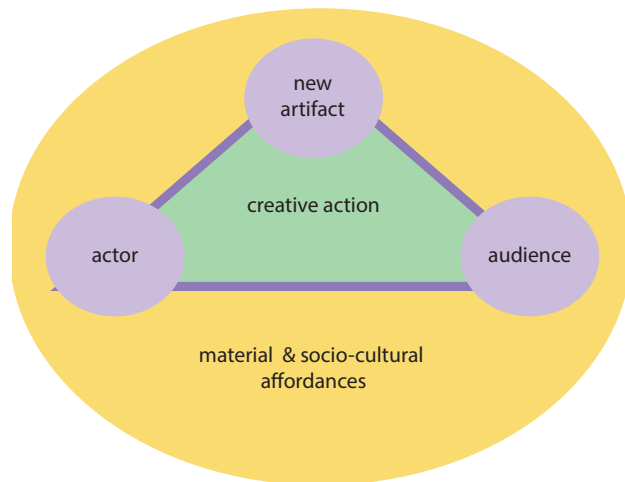


Figure 8. Integrating the 5 A's of creativity. Reproduced from Glăveanu (2013).

## Key finding

### How is creativity defined?

- Creativity can be seen as a dynamic and social process. It happens through the interaction of actors, audiences, artifacts, actions, and affordances, which constantly affect and shape each other.

## 3.1.2 Reading guide

The literature review follows the structure of the 5 A's framework, where each "A" is discussed in a dedicated section that addresses one or more of the research sub-questions, shown in figure 9.

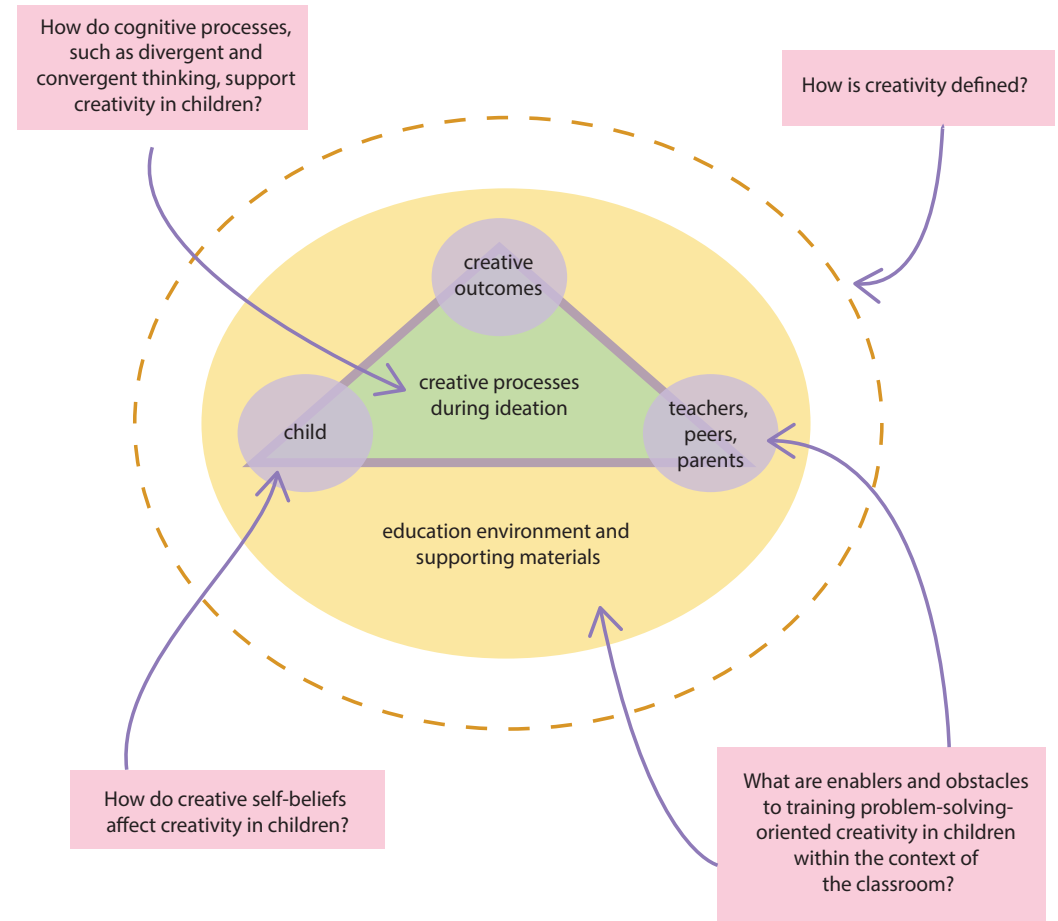


Figure 9. Framework of the 5 A's of creativity with connected research questions. Adapted from Glăveanu (2013).

The order of the A's starts with the more tangible elements of creativity (Artifact, Actor, and Audience), followed by their interaction (Action), and then gradually zooms out to the broader social and environmental context (Affordances).

## 3.2 Artifact: the creative outcomes

5 A's	Original meaning (Glăveanu, 2013)	In simpler terms	Meaning within context
Artifact	Cultural object embodying meaning, shaped by cultural traditions	Created thing or idea, shaped by culture	Creative outcomes like sketches, ideas, or design concepts created by the child

The first 'A' within the framework is Artifact, which explores the outcomes of creative processes. In the given context, it refers to the ideas generated in the ideation phase in the design process. The ideation phase involves engaging in activities that focus on creating and developing ideas to solve a specific goal (Gonçalves & Cash, 2020). However, not all ideas produced during idea generation can be considered creative.

One way to determine if an idea is truly creative is by examining Amabile's definition. Her research has been highly influential in understanding creativity and has become a foundational reference in the field. She emphasizes that, for an idea to be considered creative, it must show both **novelty and usefulness**. Novelty describes whether an idea is original and unique, while usefulness indicates whether the idea effectively solves a given problem.

If an idea is neither novel nor useful, it doesn't add anything new or solve the problem, making it not creative in this definition. If an idea is novel but not useful, it might be interesting or surprising, but it doesn't solve anything. On the other hand, if it is useful but not novel, it might solve the problem well, but in a way that has already been done before. Having this definition helps make sure the project has a clear and consistent focus, especially when looking at the actual generated 'creative' ideas by kids.

### Key finding

- An idea is considered creative when it is both novel and useful, this definition is used throughout the report to evaluate whether ideas are 'creative' or not

## 3.3 Actor: the child doing idea generation

5 A's	Original meaning (Glăveanu, 2013)	In simpler terms	Meaning within context
Actor	Person embedded in field of social relations and cultural traditions	Person creating within social and cultural world	Child (age 9-12) engaged in idea generation and people who influence the creation

To understand how creativity is influenced from the perspective of the Actor, it is important to examine how various psychological and contextual factors interact, especially **how creative self-beliefs affect creativity in children**. Some of the factors this part will dive into are necessary skills, cognitive capacities, creative self-beliefs, and educational influences.

### 3.3.1 What it takes to be creative

A starting point for exploring the Actor's creative engagement is to consider how someone is actually able to produce creative outcomes, or in this project context, generate ideas. Amabile (1983) outlines three components that are necessary for an individual to act creatively. The first component is to have domain-relevant skills, such as having knowledge or technical skills. This is also emphasized by Lewis (2006), who argues that having knowledge is an important requirement for being creative. The idea behind this is that without an understanding of the subject or problem area, the ability to generate ideas is limited.

The second core component are the creativity-relevant processes, which refer to cognitive styles and the personality of the actor. This is linked to the 'doing and thinking' in creativity and will be elaborated on in the 'Action' part.

The final core component explained by Amabile (1983) is intrinsic task motivation, which is the internal drive to engage in a task. She found that people with high extrinsic motivation within their jobs took fewer risks and because of that, their supervisors judged their work as not



! very creative. Within the school environment, Hadini (2015) explains that extrinsic rewards can drive interest and new skills, but ultimately intrinsic motivation leads to more interest, engagement, making kids try harder when things get difficult, which ultimately leads to more creative output.

Another key impact on motivation is the creative self-beliefs someone has about themselves. Creative self-beliefs can be seen as critical factors that make creativity possible (Beghetto & Karwowski, 2023) and are a core concept in explaining the influence of the Actor on creative outcomes.

🔍 In exploring pedagogical strategies to support children’s design skills, Klapwijk and Stables (2023) reference the work of Looijenga (2021) on how to effectively engage primary school students. Based on multiple case studies, Looijenga found that children often become disengaged when their basic psychological needs for autonomy, competence, and relatedness are not met. When these needs are supported, students tend to show greater motivation and enhanced creativity. To foster this, design tasks should be clearly defined, include explicit criteria, and offer opportunities for children to share their personal knowledge and experiences.

! Based on multiple case studies, Looijenga found that children often become disengaged when their basic psychological needs for autonomy, competence, and relatedness are not met.

### 3.3.2 The power of creative self-beliefs

! As briefly mentioned in the introduction, creative self-beliefs refer to whether and how people see themselves as creative. Beghetto and Karwowski (2023), explain that creative self-beliefs are the creative perception people have of themselves and that these beliefs influence their creative output. For example, if a child believes that they are not very creative, their ideas during idea generation can consequently be less creative, due to low motivation, low engagement in the task or not seeing the value of doing the task. This makes creative self-beliefs a key influence for the goal of enhancing creativity in kids.

Within the concept of creative self-beliefs are three major categories: Creative confidence, creative self-awareness and creative self-image (Beghetto & Karwowski, 2023), explained in figure 10.

**Creative self-beliefs** refer to **whether** and **how** people see themselves as creative

Major category	Subcategory
<b>Creative confidence</b> Belief in one’s ability to think or act creatively in and across performance domains	<b>Creative self-concept</b> Holistic cognitive and affective judgments of creative ability in and across particular domains
	<b>Creative self-efficacy</b> Perceived confidence to creatively perform a given task, in a specific context, and at a particular level
<b>Creative self-awareness</b> Beliefs about the nature of creativity itself, people’s appraisals of their own unique creative strengths and weaknesses, and the self-regulation of behaviour and emotions during task engagement	<b>Creative mindset</b> Beliefs about the nature of creativity itself (e.g., is creative competence fixed, incremental, or both?)
	<b>Creative metacognition and self-regulation</b> A combination of self-knowledge (i.e., belief about one’s creative strengths and weaknesses) and contextual knowledge (i.e., beliefs about when, why, and how to be creative)
<b>Creative self-image</b> Beliefs about the value of creativity, appraisals of the risks involved, and the role creativity plays in one’s broader sense of self	<b>Perceived value of creativity</b> Belief about the value, merit, or worth of creativity in relation to one’s broader sense of self
	<b>Willingness to take creative risks</b> Beliefs about one’s willingness to take creative risks

Figure 10. Summary of creative self-beliefs. Reproduced from Beghetto & Karwowski (2023).



Each major category can be divided into subcategories. These categories are not isolated, but rather, they form a dynamic system of beliefs that influence and reinforce each other (Karwowski, Lebuda, & Beghetto, 2019). From this point onwards, the focus will be on creative confidence, as it serves as a starting point for agency: it directly enables children to participate in creative tasks, making it an immediate and practical target for design. While self-image and self-awareness remain important, they are more indirectly captured in this study and could form the basis for future research. The focus of this study will be on creative confidence, as it directly supports children's engagement in creative tasks in the present, while also fostering the self-beliefs necessary for creative growth over time.

Creative confidence is broadly defined as the 'belief in one's ability to think or act creatively in and across performance domains' (Beghetto, 2013). This creative confidence is built through creative self-concept (a general belief in one's creative ability) and creative self-efficacy (confidence in performing creative tasks in specific situations) (Beghetto, 2013). Creative self-efficacy is defined as future-oriented and highly dynamic, which aligns well with children growing up: they are still forming beliefs about their abilities and are more open to influence through encouragement, feedback, and experience.

### 3.3.3 Gaining creative confidence through creative activities

Since creative confidence is dynamic and shaped by experience, childhood offers a valuable opportunity to support its development from a young age, as children are still constructing their understanding of who they are, what they are capable of, and their place in the world.

Of particular importance is the research by Atwood-Blaine et al. (2019), who found that children (aged 9-14) can significantly improve their creative self-efficacy simply by participating in creative activities. The creative self-efficacy was measured before and after playing a game and creating a multimedia poster, and a significant increase in their confidence to perform creative tasks was observed.


The activities used in the study needed to target multiple aspects to qualify as 'creative activities.' These aspects are based on Hadani's (2015) framework of 'critical components of creativity,' which include imagination, decision-making, flexibility, communication, collaboration, motivation, and movement. Figure 11 shows the elements. Appendix C summarizes each component and highlights its role in nurturing creativity.





Figure 11. Critical components of creativity. Adapted from Hadani's (2015)




The importance of motivation has been mentioned before, and the Science Hub highlighted the need for decision-making, communication and collaboration in earlier research projects.

 Within the Your Turn toolkit, decision-making is made explicit in the set of design tools around evaluating and selecting ideas after the ideation phase (Klapwijk et al., 2021). However, it is worth noting that Van Broekhoven et al. (2022) found that active guidance is necessary in this process to protect children from their own bias, as many children choose realistic over original ideas in the decision-making process.

 The aspect of communication is recognized by the Science Hub as a key skill to work in teams but also to present and share ideas. A case study with pupils aged 9–12 showed that presenting to real stakeholders required specific language skills, which most kids struggled with (Silva Ordaz, Klapwijk, & van Dijk, 2018). They found teaching strategies to help kids with different ways of presenting, but also the influence is of body language, gestures and role-play. While presenting ideas may be less central during the idea generation phase, learning about these communication techniques can still support peer interaction and collaborative work. However, imagination, flexibility and movement are new interesting elements to keep in mind.

 So, engaging in creative activities is, in itself, essential for building creative confidence. Kelly and Kelly (2013) take this a step further and explain that experiencing multiple small successes while doing creative tasks is even more beneficial. These small wins can gradually reduce self-doubt and build creative confidence, making it easier to approach future creative challenges.

 A similar viewpoint on creative activities is found in a case study by Klapwijk and Van Den Burg (2019). Children were asked to pause midway through a brainstorming session and reflect on their divergent thinking by looking at the learning goals of the activity. This simple intervention helped the children to articulate what effective divergent thinking looked like, identify strengths and weaknesses in their own approaches, and adjust their strategies in real time. Such moments of reflection can serve as a “little win”, instead of just celebrating outputs,

learners celebrate insight into their own creative growth, which in turn strengthens creative confidence.

Also, when doing creative activities, McGehee (2022) concluded that having a lack of domain-relevant skills can hinder creativity (linked to the previously mentioned research by Amabile (1983), while psychological safety (Edmondson, 1999) encourages risk-taking and consequently creative behaviour. Psychological safety is related to the idea of a ‘brave space’, which will be further explained in the ‘Affordances’ section.



## Key findings

### How do creative self-beliefs affect creativity in children?

- Creative self-beliefs shape children’s creative output.
- Children’s creativity depends on active engagement and motivation, which are strengthened when they believe in their own creative abilities (creative confidence).
- This confidence grows through experience, as simply taking part in creative tasks helps children build trust in their own creative capacities.
- To be effective, these tasks should be tailored to children’s level of knowledge, target different skills (such as imagination, collaboration, and communication), and include moments to pause and reflect on the process

## 3.4 Audience:

### The role of teachers, peers and parents

5 A's	Original meaning (Glăveanu, 2013)	In simpler terms	Meaning within context
Audience	Multiple others who evaluate, contribute to, and engage with creation	Others who engage with and evaluate the creation	The role of teachers, peers and parents as social influences

The role of teachers, peers, and parents, as captured in the 'Audience' dimension of the 5 A's framework, is central to understanding how social influences can support or hinder the development of creativity in the classroom. The influence of the Audience is key to investigate the question: **what are enablers and obstacles to training problem-solving-oriented creativity in children within the classroom context?** In particular, this section will focus on answering the question from the perspective of teachers and peers (as collaborators) in the design process.

#### 3.4.1 Expanding the role of teachers

Within the context of education, one of the key Audiences is the teacher, especially when they are responsible for teaching design to the kids. Calavia et al. (2023) explain that teaching design requires teachers to adopt a different role. Beyond being educators, they might also need to act as coaches, resource providers, and even designers themselves. For the teachers to be able to take on these new roles, it is important to properly instruct the teachers in what creativity is and how to do problem-solving design activities (Lewis, 2006).

Stepping into the new roles, there are several important factors to consider and actively put into practice. It already starts before the actual teaching. If a teacher expects and recognizes creative behaviour in the pupils, the creative self-efficacy of the pupils will increase, making them act more creatively as well (Atwood-Blaine et al., 2019; Plucker et al., 2004). Support from a respected figure, like a teacher, can serve as a powerful social persuasion that strengthens students' belief in their own creative ability (Bandura, 1997).

#### 3.4.2 Bias as a blocker of creativity

Karwowski (2022) expands on the influence of teachers by showing that they are particularly sceptical of 'rebelliously creative' students, who are seen as highly independent or are known to often challenge rules or norms, even if they are just as creatively capable. These biases are less about creativity itself and more about personality traits that clash with classroom norms. Because such biases can unintentionally hinder students' confidence, it is important for teachers to be aware of their biases and put it aside to better support children.

Teachers' expectations may also be shaped by assumptions about how creativity develops with age. Some scholars have described the 'fourth-grade slump', a sharp drop in creativity around age 9 and 10 (Torrance, 1968), while others have observed a more gradual decline in creative self-beliefs as children progress through school (Beghetto et al., 2011). Still, more recent analyses suggest that the overall developmental trajectory is more complex and depends on factors such as measurement method, cultural context, and participant characteristics (Karwowski, 2022; Said-Metwaly et al., 2020). These mixed findings highlight the importance of not letting such assumptions bias teachers' perceptions, but rather of creating learning environments that actively nurture creative thinking, especially during late childhood when these questions are most often raised.

On the more practical side, Beghetto et al. (2011) highlight that supervisory support and positive feedback from teachers can also significantly boost the creative self-efficacy of children, during the creative process.

This suggests the design should include features that create space for encouraging children through positive feedback, increase teachers' awareness of their role as role models and of their potential biases, all while supporting the teacher in the design process.

### 3.4.3 Peer dynamics in creative teamwork



Next to the influence of teachers, the role of fellow students is also important to consider. Many idea generation techniques rely on teamwork, and several of the design tools in the Your Turn toolkit are explicitly built around collaboration. In research with children, Van Mechelen et al., (2014) observed a range of group dynamics that shaped the design process, either in a positive or negative way. Some of these influenced the level of engagement, for example when participation was unequal or when one child took on a dominant role. Others were more closely related to motivation, such as treating the task too lightly or rushing too quickly to agreement. These dynamics illustrate how peers can significantly shape the collaborative process and affect how children engage with creative activities. Followed by the finding of these dynamics, Van Mechelen et al. (2015) explain that within design projects, teamwork should be treated as a learning process as well. In particular, structured reflection on collaboration has been shown to help children recognize unhelpful behaviours and develop strategies to improve group work over time.

#### Key findings

What are enablers and obstacles to training problem-solving-oriented creativity in children within the classroom context?

*Looking at teachers and peers specifically*

- Teachers play an important part in enabling creativity and need to adopt new roles, but to do so they first require clear instruction in the meaning and value of creativity and design activities.
- Before engaging in the classroom, teachers need to be aware of their own biases and expectations, as viewing students' creative skills positively makes students more likely to believe in and act on their own creative abilities.
- During creative action, teachers need to provide feedback and offer support.
- Peer dynamics can both enable and hinder creativity. Treating teamwork as a learning process, with reflection on group work, helps children overcome these obstacles and build stronger creative problem-solving skills.

## 3.5 Action: the creative process

5 A's	Original meaning (Glăveanu, 2013)	In simpler terms	Meaning within context
Action	Coordinated psychological and behavioural manifestation situated in context	Doing and thinking involved in creating something	Creative process in doing idea generation

The 'Action' in the 5 A's of creativity refers to the mental and physical processes involved in generating ideas and dives into **how cognitive processes, such as divergent and convergent thinking, support creativity in children.**

Action emerges from the interaction of the Actor, Audience and with the Artifact, and includes the thinking and doing involved.

One way to understand how we think and understand things, is through the concept of cognition. Copley (1999) describes cognition as the mental process of acquiring, organizing, interpreting, and using information. Cognition is made possible by cognitive abilities, including the creative thinking processes known as divergent and convergent thinking.

### 3.5.1 Divergent and convergent thinking

Before Amabile's influential contributions to creativity research explained earlier, Guilford (1950) also explored the meaning of creativity. For a long time, researchers considered creativity to be an intellectual ability, so closely tied to someone's intelligence. People believed that being creative simply meant having a high level of intelligence or smart thinking, so creativity and intelligence were often treated as the same thing. However, Guilford was one of the first to challenge the idea that creativity is simply an expression of intelligence and instead explained creativity as divergent and convergent thinking.

Divergent thinking refers to the ability to generate many different solutions to a problem, while convergent thinking narrows it down again to one 'right' solution (Gonçalves, 2016).

However, divergent and convergent thinking are not two stand alone types of thinking. They follow up on one another and the ability to shift continuously between these two types of thinking is very valuable to train creativity. So, it is important for children to practice this when learning to design (Schut et al., 2019).

So, on one hand, understanding these two types of thinking means that creativity can be supported by targeting and taking into account both kinds of thinking in design activities. On the other hand, this insight is valuable for teachers too. Instead of seeing creativity as something children are just born with or a sign of being 'smart', creativity can be understood as a set of skills that anyone can develop. Teachers can help students come up with many ideas and learn how to shape them, while keeping the creative process of divergence and convergence in mind.

### 3.5.2 Ways of Supporting Divergent Thinking

Divergent thinking, defined as generating many different solutions or ideas to a problem, can be challenging for people, so many different tools and techniques have been developed to help with creative thinking. In a study on enhancing student creativity, Sun et al. (2020) demonstrated that actively training students in different techniques, significantly improved their creative performance. The techniques used in research were based on three elements: association (connecting different ideas or things together), decomposition (breaking big problems, ideas or products into smaller parts), and combination with adjustment (Putting ideas together but changing them a little to make something new) (Sun et al., 2020).

Other divergent thinking techniques that increase creativity can be brainstorming or asking explorative questions, while fostering a non-competitive and relaxed environment. Howard-Jones (2002) found that these techniques and environment led to more original ideas compared to students who were simply asked to generate ideas without any guidance.

Humour has also been identified as a valuable tool for enhancing divergent thinking in creative contexts. Flowers (2001) suggests that incorporating humour into design and problem-solving can lead to the generation of varied and original ideas. This aligns with the broader idea in creativity research that factors like enjoyment and intrinsic motivation foster creativity (Lewis, 2006).

Building on the link between humour and creativity, a study comparing improvisational comedians, product designers, and others found that comedians generated both a larger number of ideas and more creative ones (Kudrowitz & Wallace, 2010). Their improvisation training, including short-form association games, significantly boosted their idea generation abilities. This suggests that exercises encouraging non-obvious connections, playful thinking, and association could help children produce more and more creative ideas.

### Key findings

How do cognitive processes, such as divergent and convergent thinking, support creativity in children?

- Creativity is a cognitive process, not just intellectual ability. Moving beyond the outdated view that creativity equals intelligence, research shows it relies on specific mental processes, especially divergent and convergent thinking.
- Divergent and convergent thinking work in sequence. The ability to switch between generating many ideas (divergent) and narrowing them down (convergent) is essential and can be practiced and developed.
- Understanding creativity as a trainable cognitive process also helps shift perceptions away from creativity as something you are born with or not, toward something that all students can learn and improve.
- Divergent thinking can be challenging, but there are many different techniques (such as association, asking explorative questions or playful improvisation), to support it. These strategies help children generate more original ideas, showing that creativity grows when cognitive processes are actively supported.

## 3.6 Affordances:

### Materials and classroom environment

5 A's	Original meaning (Glăveanu, 2013)	In simpler terms	Meaning within context
Affordances	Cultural, material, and social conditions enabling creativity	What the environment allows or offers to do	Provided (design) material and classroom environment

The final 'A', Affordances, highlights the importance of the environment in shaping creative behaviour and investigates the question: **what are enablers and obstacles to training problem-solving-oriented creativity in children within the context of the classroom?** It is the overarching layer of the 5 A's framework that shows how creativity is supported by the surroundings that make it possible or invite it in. Affordances can either encourage exploration and risk-taking or subtly discourage creative engagement.

#### 3.6.1 The impact of education on creativity

Education plays a central role in shaping how children develop as creative individuals, making it a key context for understanding the factors that influence creativity early in life. The role of schools in developing creativity is still debated. Some believe it supports creative growth, while others argue it may unintentionally limit it, especially as children grow older.

A commonly known opinion among educators is reflected in the most viewed TED Talk to date called 'Do schools kill creativity?' by Robinson (2006), where he argues that even though children are born creative, the educational system teaches them not to be. He elaborates on this by explaining that the educational system is too focused on standardization and conformation, like giving grades and assessing work that is either right or wrong (Robinson, 2011).

A different viewpoint is proposed by Karwowski (2022) in 'Schools do not kill creativity', where he explains that creative and educational processes often go hand in hand. In both processes, there is a need for creative confidence, valuing the task and self-regulation to be

successful and for the student to be motivated. Still, this raises the question: do traditional school settings truly give students the space to find personal meaning in tasks and regulate their own learning, or do many students complete creative assignments simply because they are required to?

#### 3.6.2 Classroom conditions

In the context of enhancing creativity in education, the environment is shaped both by the broader educational context and 'Audience', as well as by specific classroom conditions. Multiple studies emphasise the importance of a classroom culture that makes room for failure, in contrast to traditional school activities where outcomes are often seen as either right or wrong (Lewis, 2006). Making room for failure and the earlier mentioned risk-taking, can be fostered within the concept of a 'brave space'.

In contrast to a 'safe space', the brave space encourages people to take risks and step into discomfort (Arao & Clemens, 2013), so they are actively engaged and feel more agency, which are previously mentioned elements to grow creative confidence. However, stepping into a brave space can feel daunting, as it requires embracing vulnerability and uncertainty. Therefore, several guidelines have been proposed to guide how to build a brave space. Stubbs (2019) for instance, introduced the 'six pillars of a brave space', which include: vulnerability, perspective-taking, leaning into fear, critical thinking, examining intentions and lastly mindfulness, shown in figure 12.





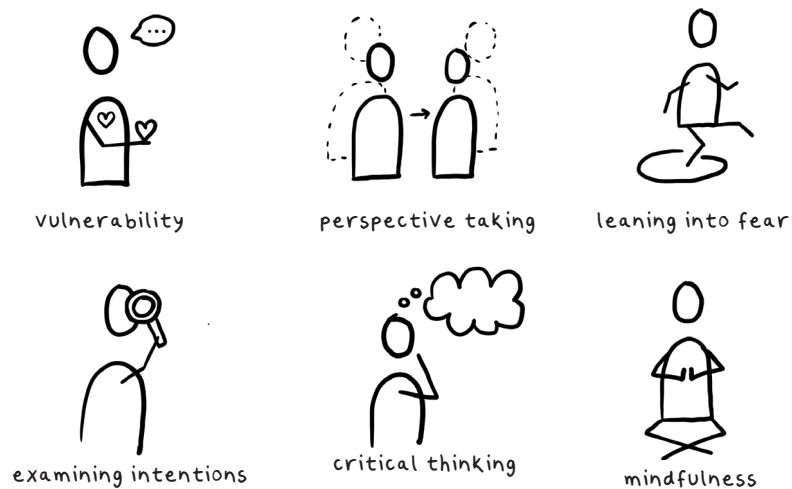


Figure 12. Visual of the brave space pillars based on Stubbs (2019)

Vulnerability invites both teachers and students to be open about not knowing, sharing parts of their own story, or risking mistakes. Perspective-taking means listening with curiosity to the lived experiences of peers, without needing to adopt their viewpoint but striving to understand it. Leaning into fear encourages kids to see discomfort as an opportunity for learning and growth, rather than something to avoid. Through critical thinking, people engage with ideas rigorously and fairly, challenging assumptions while staying open to critique. Finally, examining intentions and practicing mindfulness ensure that contributions are thoughtful, self-aware, and grounded in the present moment, helping to create an environment where meaningful conversations can happen.

A leading study in creative thinking for the development of the 'Your Turn' materials gave insight into ways to help create an environment in which creative action can flourish (Klapwijk, 2017). The research emphasised the role of the teacher in helping children generate ideas, as they can make a big difference in supporting creativity, and is in line with the previously mentioned research by Howard-Jones (2002) on fostering creativity in the classroom. Especially strategies 2, 3 and 4 are key within designing for the idea generation phase in the design process.

The 5 key strategies for fostering an environment for children to enhance their creativity are:

1. Open problem formulation: Using open but tangible identified problems to help children get started with designing,
2. Shifting between divergent and convergent thinking: Supporting the balance between these, but also making room for iteration and sharing ideas,
3. Using energizers and various divergent thinking techniques: Helps with generating ideas, at the same time create an open atmosphere by using the **brainstorm rules** (Wetenschapsknooppunt TU Delft & ontwerpbureau Meeple, n.d.):

Everything is allowed  
Postpone your judgement  
Create as many ideas as possible  
Ideas are owned by every-one!  
1+1=3  
Draw  
Give each other compliments

4. Iteration, rapid prototyping and embracing failure: Kids freely test and improve ideas, without being too attached to their ideas,
5. Assessment of creative thinking: Clarifies what can be learned through design activities.



## Key findings

### What are enablers and obstacles to training problem-solving-oriented creativity in children within the classroom context?

*From the perspective of the general environment*

- At the school-wide level, creativity can be hindered by education systems that prioritise standardisation and conformity, such as grading and right–wrong assessments. These structures may create a fear of failure and reduce students' willingness to take risks. To counter this, environments that emphasise creative confidence, task value and self-regulation can support children's creative development.
- Within the classroom, a culture that normalises failure as a way to learn from mistakes and encourages risk-taking is essential. Establishing a brave space, where elements like vulnerability, critical thinking, and leaning into fear are actively encouraged, provides children with the psychological safety and agency needed to build creative confidence and strengthen problem-solving-oriented creativity.

## 3.7 Conclusion

The literature review explored the research question: **“How is creativity supported during the idea generation phase among primary school children aged 9 to 12?”** The question can be answered by considering the interplay of cognitive, social, and environmental factors that shape children's creative development in schools.

Based on theoretical insights, the research question can be answered as follows:

### What creativity is:

Creativity is not a fixed trait, but a dynamic, social process shaped by the interaction of the actor, audience, artifact, action, and affordances. So, it is key to consider how creativity must be supported in context, to see how it can be best supported.

### How types of thinking support creativity:

Thinking supports creativity because it involves trainable cognitive processes, specifically the ability to generate many ideas (divergent thinking) and narrow them down (convergent thinking). By practicing these mental strategies, all students can develop more original and effective solutions.

### How creative confidence supports creativity:

Children's creative output is strongly shaped by their creative self-beliefs and directly influences children's motivation and engagement in creative tasks. Creative confidence specifically, grows through participation in creative activities, especially when tasks match their knowledge, encourage collaboration, and allow moments of reflection.

### How the classroom environment supports creativity:

Teachers and peers are both enablers and obstacles. Teachers need to move beyond functioning as educators alone to becoming guides and supporters, but this is only possible if they themselves have a clear understanding of creativity. On a broader level, school systems emphasizing right-or-wrong culture restrict risk-taking, which is essential to foster brave spaces, where failure is reframed and students' sense of agency is strengthened.

Peers support creativity most effectively when opportunities for structured reflection during collaboration are provided.

### *Reflection on creative confidence and creative self-beliefs*

While the main focus point of the literature study has been on creative confidence, as it is the most immediate and actionable starting point for children's agency, the literature findings also implicitly touch on children's broader self-image and self-awareness. As mentioned in section 3.3, Karwowski, Lebeda, and Beghetto (2019) highlighted that all creative self-beliefs are part of a connected and dynamic system. Though the main focus will remain on creative confidence, future research could extend research on examining how these different self-beliefs interact, and by developing tools to capture their wider influence on creativity in education.



# context research

- 4.1 current materials
- 4.2 teacher context interviews
- 4.3 Science Hub context interviews
- 4.4 conclusion

This chapter explores the current educational context of Your Turn through looking at current materials and by interviews with teachers and educational experts. While the literature review addressed the research question from a theoretical perspective, this chapter considers it from a practical perspective.



# 4.1 Current Your Turn materials

To understand where the opportunities for expanding the Your Turn lie, an overview of the existing idea generation tools in the Your Turn toolkit will be examined and reflected upon.

Second, the existing knowledge and resources available about creativity in the context of Your Turn will be reviewed, from the perspective of teachers who have no prior experience with design and are looking to introduce design activities into their classrooms. This review aims to identify what support is currently available and how accessible and practical it is.

## 4.1.1 Current design tools

The Your Turn toolbox contains a list of individual design tools, organized into the five steps of the design cycle introduced earlier (figure 13). For example, the first group of tools support the first phase of the design process, exploring and formulating the problem. These tools help children build empathy with end users, reflect on their own experiences, and map the design environment.

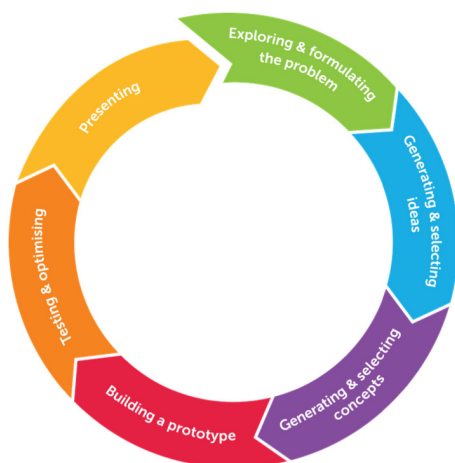


Figure 13. Design cycle used in the Your Turn materials (Klapwijk et al., 2021)

The next step focuses on generating and selecting ideas, which is divided into ideation tools and evaluation tools, such as brainstorming methods, idea-rating techniques, feedback activities, and voting strategies. Once a concept is chosen, prototypes are built, tested, and presented in different formats for design pitches.

As the focus of this project is on idea generation, the five design tools that support this are the Inverse Brainstorm, Picture Brainstorm, Word Brainstorm, Open Your Senses, and Combine and Fantasize (figure 14).

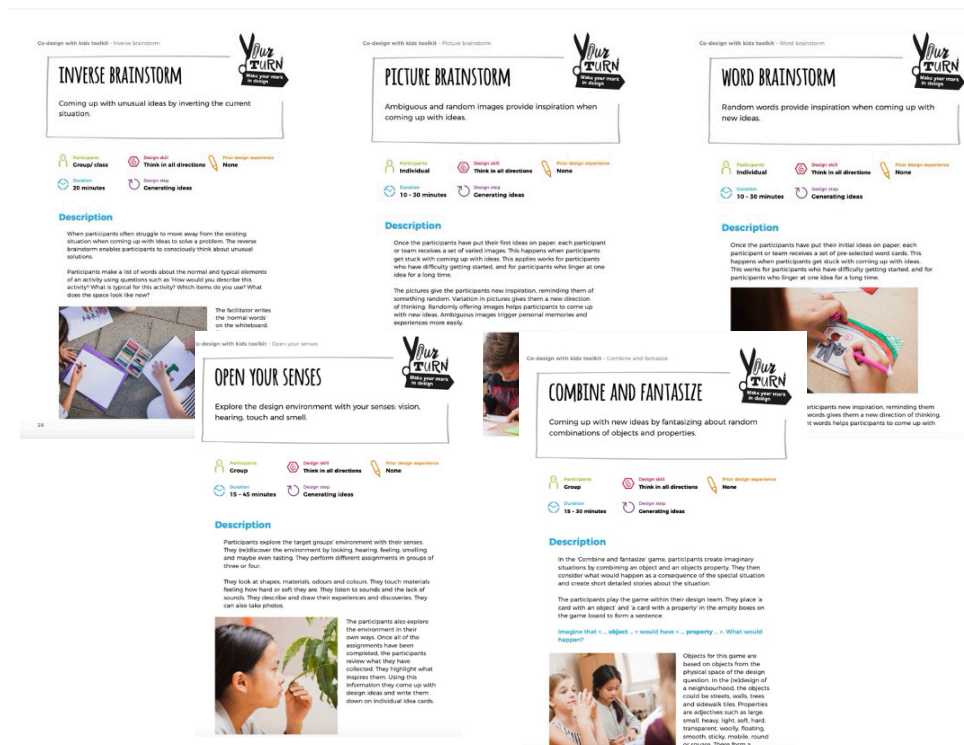


Figure 14. Overview of current idea generation tools (Klapwijk et al., 2021)

Each method provides a different entry point into the creative process and is adapted from established design ideation techniques originally developed for professional contexts. Their adaptation for children makes them accessible and easy to understand, while maintaining the core purpose of stimulating creativity.

The Picture Brainstorm and Word Brainstorm methods are designed to provide a spark of inspiration when children get stuck. By introducing external prompts, either through images or words, they help children to explore new directions.

The Inverse Brainstorm similarly invites participants to flip assumptions and look at problems from unexpected angles, providing an open and flexible starting point for ideation. The teacher guidebook (Klapwijk et al., 2021) highlights that it is especially useful when a class is still learning how to generate ideas, as it is done in collaboration with the whole class.

Combine and Fantasize adds an element of playfulness, encouraging children to merge objects with varying object qualities into imaginative ideas. This method often sparks surprising and original outcomes, but it does need to be adapted to the design challenges for the best outcome. Open Your Senses has a very different approach compared to the other current methods in the toolbox, focusing on observation and sensory exploration. It grounds creativity in real-world experiences and invites participants to notice their surroundings in new and meaningful ways. Both methods are especially suitable when a location is an important aspect and are mentioned to generate more original designs (Klapwijk et al., 2021).

## Reflection

Together, the methods provide a good and versatile foundation for supporting ideation with children. They balance accessibility with creativity, and they encourage divergent thinking through verbal, visual, and sensory modes. At the same time, based on the research findings, there remains room to further support children in actively engaging with their creative thinking. This could include providing stronger starting points for idea generation, encouraging more collaborative teamwork and building on each other's ideas, exploring new modes of expression beyond verbal and visual formats, and reducing the likelihood of participants getting stuck.

## 4.1.2 Teacher Support in Design

Alongside the existing design tools, Your Turn also provides knowledge and resources on creativity in different forms. These resources will be reviewed with a focus on how they support teachers who have no prior experience with design but wish to introduce design activities in their classrooms.

Previous literature has emphasized the crucial role of teachers in fostering creativity, for example, by providing feedback and creating supportive environments. At the same time, it underlines the importance of teachers developing an understanding of design and creativity, as well as recognizing the role they play in facilitating these processes.

### Guidebook Your Turn for the Teacher

The central and most important resource for teachers is the Guidebook Your Turn for the Teacher (Klapwijk et al., 2021). This guidebook is practical in nature and designed to help teachers set up their own design projects. It begins by explaining why and how to start a design project, using a “design topic chart” as guidance. It then introduces a set of design tools, supported by a “design flow chart,” and concludes with notes on the learning process (see figure 15).

Creativity is introduced in the opening chapter as one of the 21st-century skills that can be fostered through design. The need for ‘proper guidance of teachers’ in learning design is highlighted in explicit ways of how teachers can support children by providing examples, talking about the learning goals and providing feedback.




Figure 15. Teacher Guidebook (Klapwijk et al., 2021)

The first chapter introduces teachers to the concept of design and its link to creativity, as illustrated in the following passage:

“Creativity is always about something that is not yet there; it is about the future. Designerly thinking is an excellent vehicle to develop creative thinking in classrooms and can be applied to any topic – from designing a digital game to learning mathematics, from developing an environment for polar bears to organising an Easter party for parents.” (Klapwijk et al., 2021, p. 7)

The guide then explains design as an iterative process and outlines the steps of the design cycle. It provides practical advice for setting up projects, from choosing engaging themes to involving real-world stakeholders. It also highlights various learning goals connected to 21st-century skills. Within the context of idea generation, the ability to “think in all directions” is most frequently referenced. Other skills, such as learning from mistakes and engaging with the process, are also linked to creativity.

Insert image



The final chapter focuses on the learning process. It emphasizes discussing learning goals and success criteria with students, providing constructive feedback, and using examples to guide children’s progress. The examples are often given alongside some tools, so pupils can practice with a design tool before applying it to their own projects, and teachers can also demonstrate activities using these examples.

### Other Resources for Teachers

In addition to the guidebook, the Science Hub at TU Delft shares research and developments through its website (Wetenschapsknooppunt TU Delft, n.d.).

For teachers who wish to deepen their understanding of creativity in particular, the “Creative Thinking” section is especially relevant. The main insights presented focus on the “generating and selecting concepts” phase of the design process, which follows the initial idea generation. Key themes include divergent and convergent thinking, fixation, and the role of feedback.

### Reflection

Some critical elements for teachers to know are covered in the current materials, like divergent thinking, the need for clear learning goals and giving feedback. Some essential literature findings are however not mentioned, like the influence of creative confidence, the influence of expectations and bias, the need for reflection and actively fostering brave spaces. This gap highlights an opportunity to further support teachers by integrating these elements into the materials, helping them more effectively foster creativity and a supportive classroom environment.



## 4.2 Teacher context interviews

The teacher interviews investigated whether the theoretical findings align with practice, focusing on **definitions of creativity at schools** and **the enablers and obstacles the teachers experience in teaching creativity in primary schools** today.

To gain these insights, six semi-structured interviews were conducted with primary school teachers working with groups 5 to 8 (ages 9-12) in a variety of Dutch primary schools and one teacher from an international school (School 5, see figure 6, Chapter 2.4.1). The purpose of these interviews was to explore what knowledge teachers have about creativity, whether and how they teach it, and how they support students in thinking creatively. The interviews were kept open in structure to identify whether certain areas of creativity were more familiar or unfamiliar to some teachers, and to better understand varying perspectives on creativity in primary education across different schools. The full interview guide can be found in Appendix D.

The insights gathered from the interviews were grouped into thematic areas.



### Teachers' personal views on creativity

When asked how they see creativity reflected in primary education, most teachers initially associated it with arts and crafts (Dutch: handvaardigheid). Upon reflection, some expanded their views, mentioning skills like problem-solving, or noting that creativity can, in fact, be found in nearly every subject area.

### Creativity in the school's educational vision and materials

None of the schools had a specific method or curriculum for teaching creativity, and only some had one for teaching art (also aimed at creativity, but not specifically at problem-solving). Teachers commonly noted a lack of time to prepare lessons, leading them to prefer short, straightforward activities. In the absence of structured methods, many turn to platforms like Pinterest for lesson inspiration, particularly for art classes.

Some teachers observed that creative subjects like art and music are often the first to be skipped when schedules are tight, while subjects like math are prioritized daily. Additionally, they mentioned how creativity is sometimes seen as more appropriate for the 'smarter' students. Creative challenges are occasionally reserved for the 'plusklas' (enrichment classes), rather than the entire class. This is often due to a focus on ensuring that all students first master the basic learning goals. Teachers may hesitate to offer open-ended, creative tasks to the whole class if they are unsure whether some students fully understand the core material. As a result, creative assignments are sometimes positioned as optional extras or extensions, rather than core tasks, to avoid overwhelming students who may still be working on foundational skills.

### Evaluation and feedback practices

Most teachers noted that their schools do not have clear definitions or guidelines for evaluating creativity. Although most subjects in school receive formal grades, art classes, which teachers associate most with creative work, are rarely graded in the same way. When teachers are required to assess creative work, they often struggle with what criteria to use: should they judge the final product, the effort, the process, or the neatness? These aspects are rarely specified.

Some schools make use of grading rubrics with predefined criteria. Teachers found that these helped students by providing clear expectations and goals. However, one teacher recounted a downside: when students produce visually attractive work that doesn't meet the rubric requirements, they sometimes become frustrated by a lower grade. Yet, this frustration can lead to deeper engagement, students who redo their projects often end up feeling more proud of the final result.

While giving feedback during (creative) activities for kids to iterate their tasks isn't yet a common practice, most teachers are beginning



to include it in their lessons. They noted that when students are used to feedback, they no longer perceive it as rejection, which highlights the importance of consistently including feedback throughout their education.

Teachers in Dutch schools largely work within a right/wrong evaluation culture. One teacher mentioned that this black-and-white approach limits creativity. Interestingly, the teacher from the international school, where no grades are given, shared that even there, some of the brightest students cannot stand to be wrong and can get upset if they do not know it all.

### Why children get stuck in creative exercises

Most teachers observed that students often get stuck during creative tasks. They struggle with how to begin, continue, or adapt an idea. Several reasons were offered: thinking independently is challenging, and copying an example is a safer, easier route.

Teachers also noted that as children grow older, their creativity tends to decline. This was attributed to a kind of “reality check,” where children dismiss imaginative ideas as unrealistic. Also, factors like intellectual ability, home environment, and upbringing play a role in how easily children engage in creative tasks.

### How teachers stimulate student creativity

Every teacher said that when kids ask them for help, they encourage the kids to find the solution themselves by asking explorative questions like: “How would you solve this problem?” or guiding their thinking process step by step, without revealing the answer.

Some teachers encourage creative thinking subconsciously and ‘in the moment’, while others apply more structured approaches: having students write down keywords, combine 2 completely different things together, use visuals instead of words, or participate in ‘chalk talk’ where kids build on each other’s ideas.

One teacher shared how she uses a storybook to spark imagination. During reading it, she would stop and ask the children what they thought might happen next.

At first, they were puzzled,

“But it’s written in the book,” they said.

The idea of making predictions felt strange to them. However, as she encouraged them to imagine different possibilities, a few children started to engage. Over time, some began to feel confident enough to share their own ideas about the story’s direction.

## Key findings

### How is creativity defined?

- Most teachers initially associated creativity with arts and crafts, though some expanded their view to include problem-solving and creativity across subjects after reflection.
- Creative tasks are typically offered to high-achieving students in enrichment settings, while others receive them only after mastering basic learning goals, positioning creativity as an optional extra.


### What are enablers and obstacles to training problem-solving-oriented creativity in children within the classroom context?

- There are no structured methods for teaching creativity in the schools, and under time pressure, creative subjects are often skipped in to prioritise core subjects like math.
- A dominant right/wrong evaluation culture discourages experimentation, and even in schools without formal grades, students often resist ambiguity or fear making mistakes.
- Related is the finding that many students get stuck when asked to be creative, because they are afraid of being wrong or dismiss their ideas too quickly because they are not ‘realistic’.



## 4.3 Science Hub

### context interviews

 Following the conversations with teachers, the broader context of design education in primary schools was further explored through informal interviews with people involved with the Science Hub TU Delft. As mentioned earlier, this initiative brings together researchers, designers, and staff from TU Delft, in collaboration with primary school teachers, with the aim of fostering creative thinking, design, and research in the classroom. The primary focus of these interviews is to **explore the enablers and obstacles of training problem-solving-oriented creativity in children within the classroom context.**

Three informal interviews were conducted with a researcher, project leaders, and a partner from the Maakotheek, an organization engaged in supporting science and technology education (which also relates to design). They hold a valuable role that involves collaboration with schools, children, and professionals, as well as staying informed about current research developments.

Their knowledge provided valuable perspectives on the practical challenges kids and teachers face and their personal ambitions in bringing design-oriented learning to primary education.

#### Insights Your Turn researcher

The first conversation was with a researcher who was actively involved with the creation of the current Your Turn materials. Most idea generation materials in the current toolbox, were not newly invented but adapted from established design methods and reshaped to suit a younger audience.

In working hands-on with children during design activities, she observed how children often found it surprisingly difficult to generate ideas, and some would become emotionally stuck when a peer thought of a better idea.

"It's really surprising how hard it is for kids to  
come up with ideas"

Also, within the design process, particularly in group 6, children frequently lost sight of what they were designing for, even when they had formulated the design problem themselves.

#### Insights Science Hub project leaders

While these insights came from direct work with Your Turn, the Science Hub project leaders offered a broader perspective on the structural and didactic needs involved in teaching design. One insight from doing research with children was that they express themselves very differently through speech compared to writing, with written tasks often introducing unnecessary friction. When children need to explain their thinking, the project leaders found it often works best to talk with them rather than ask them to write it down.

Moreover, they observed that the stimuli used to spark inspiration, such as characters or objects, do not always reflect children's own cultural or knowledge frameworks, particularly in classrooms with diverse cultural backgrounds and upbringings.

#### Insights Science Hub partner

The partner from the Maakotheek is an expert in the current OOL ('Onderzoekend & Ontwerpend Leren) landscape, particularly through her close contact with teachers and schools. She observed that many teachers are unfamiliar with OOL and often struggle with its process-oriented nature. Since most schools focus on result-driven teaching, teachers can find it difficult to let go of control and support open-ended exploration when they begin working with design. This is understandable, as teachers make hundreds of decisions each day and often lack the time or headspace to consider multiple ways of approaching a problem. This mindset also influences students, who often stop generating ideas after coming up with just one, assuming they have already found "the right answer."



As she put it:

"Children are inherently creative, but we teach them not to be, because we teach them that there is only one correct answer."



An observation about the foundation of teaching design, is that some teachers view creative exercises as messy, time-consuming, and they lack knowledge about the underlying learning goals. Without a clear understanding of the educational value of creative activities, they often fall back on personal interpretations of what creativity means, which can be highly varied and subjective. Lastly, the experience level of both teachers and students plays a key role. Schools that have been practicing OOL for a longer time tend to be more confident and capable of working with more advanced design methods.



## Key findings

What are enablers and obstacles to training problem-solving-oriented creativity in children within the classroom context?

- During group work, especially in group 6, children can lose sight of the design goal (even if they helped define it themselves) highlighting the need for ongoing guidance and reminders throughout the process.
- Most idea generation tools used in classrooms are adaptations of existing design methods, not originally developed with children in mind, which points to the need for new, research-based tools tailored to children's emotional and cognitive development.
- Many teachers are unfamiliar with the process-oriented nature of OOL and, within result-driven school cultures, often struggle to support open-ended exploration. Without a lot of experience or support, both teachers and students tend to fall back on finding "the right answer," rather than exploring multiple possibilities.
- Teachers often rely on personal, varied definitions of creativity and may see design activities as messy or time-consuming, especially when lacking the training, headspace, or understanding of their educational value and learning goals.

## 4.4 Conclusion

To address the research question of **how creativity is supported during the idea generation phase among primary school children aged 9 to 12**, from a practice perspective, nine interviews were conducted with both practicing teachers and educational experts. Although their perspectives differed, they provided complementary insights into the real-world challenges and opportunities that children encounter when engaging in creative tasks at school.

Based on insights from practice, the research question can be answered as follows:

### How creativity is understood and supported in schools:

Teachers vary widely in how they interpret and support creativity, often relying on personal intuition or experience rather than shared frameworks or school-wide goals. This results in inconsistent practices across classrooms and schools. The lack of structured approaches or formal guidance further compounds the problem: teachers frequently fall back on improvisation or copying example activities without learning goals.

### How educational mindsets constrain creativity:

Result-driven cultures limit exploration. Both teachers and the experts stressed that high pressure to meet learning goals makes teachers prioritize "right answers" and limit room for creative exploration. This limits risk-taking and discourages iterative or open-ended creative processes in both teachers and students.

### How children experience creative idea generation

Children struggle with idea generation and confidence. The teachers and Your Turn researcher both observed that children often get stuck during creative tasks, either due to lack of experience, fear of being wrong, or emotional comparison with peers.



# 5

## defining the problem

5.1 introduction

5.2 problem framing

5.3 reflecting with creative facilitation experts

5.4 design focus

This chapter defines the design direction to guide the Research through Design process by analysing the insights from chapter 3 and 4. From the insights, the main problems were validated with insights from creative facilitation experts and turned into a clear and actionable design challenge.

## 5.1 Introduction

In this section, the first analysis of the research findings is presented through a problem-framing lens. The goal is to identify the key challenges that shape how creativity is currently supported during the idea generation phase among primary school children aged 9-12. By comparing insights from theory with insights from practice, three main problems emerge that highlight tensions between what is recommended in literature and what is experienced in classrooms.

The analysis reveals the following main problems:

1. Result-driven culture in schools restricts the creative process
2. Creative confidence is both the prerequisite and the result of creative engagement, leaving children caught in a cycle of hesitation
3. Inconsistent understanding and support for creativity among teachers.

The problem framing forms a first step in translating research insights into a design direction. The analysis shows that both children and teachers face difficulties when shifting focus from outcomes to process, which creates a shared barrier to fostering creative confidence. As a result, the design direction guiding this thesis is framed as:

**“How might we help 9–12-year-old children shift their focus from the end result to the creative process, in order to foster creative confidence, while also supporting teachers in understanding and facilitating this shift?”**

The following sections elaborate on the problem framing, the validation of the identified issues, and how these insights ultimately inform the formulation of the design question.

## 5.2 Problem framing

The insights gathered from the literature research and context research were individually mapped onto the 5 A's of Creativity framework. This allowed for a structured way to interpret and categorize the key findings and the area of creativity they most relate to. Then, the findings were combined and reorganized based on emerging similarities, which helped to identify recurring themes and patterns across all sources. The full map can be found in Appendix E.

Through the mapping analysis, three core problems appeared. The problems are presented through comparing the theoretical view with what was found in practice and describing the tension and relevance of the problem. Appendix F shows the corresponding research findings for each problem more elaborately.

### Problem 1: Result-driven culture in schools restricts the creative process

**Theory says:** Risk-taking, brave spaces, and reframing failure are essential to creativity. Divergent and convergent thinking should be practiced iteratively, and mistakes should be seen as part of the process.

**Practice shows:** Schools are dominated by result-driven mindsets, where “right answers” and efficiency take priority. Teachers feel pressure to meet goals, leaving little space for exploration. Children show similar behaviour, avoiding risks and sticking to ‘safe’ ideas.

**Tension:** Theoretical models of creativity rely on process-focused, open-ended exploration, but practice is dominated by outcome-driven constraints.

**Why it matters:** This creates a fundamental block: children can’t shift their focus to the process when the school culture pushes them towards end results.

In result-driven school cultures, both teachers and students often focus on finding the “right answer” and therefore find it hard to engage in open-ended exploration. As a result, students often fear failing, which results in holding back ideas, copying others, or avoiding creative risks

altogether. In classrooms is a need for psychological safety, for students to take risks, share ideas, and value the creative process, which can happen in a 'brave space'. There is a need to shift classroom culture, from outcome-focused to process-oriented, so students can develop creative confidence in an environment that supports experimentation, vulnerability, and learning through failure.

### **Problem 2: Creative confidence is both the prerequisite and the result of creative engagement, leaving children caught in a cycle of hesitation**

**Theory says:** Creative confidence grows when children actively engage in creative activities that encourage exploration and reflection, matching their skills and knowledge. Having more confidence further drives motivation and engagement in creative tasks, which, in turn, feeds back into the development of more creative confidence.

**Practice shows:** Children often lack confidence in creative idea generation. They get stuck, fear being wrong, and compare themselves negatively to peers. Teachers also report that children are hesitant and unpractised in thinking in all directions.

**Tension:** Creative confidence is both the prerequisite and the outcome of engaging in creative tasks. Yet many children hesitate to participate due to fear of failure or self-doubt, which prevents them from developing the confidence they need.

**Why it matters:** Building creative confidence enables children to approach creative tasks with curiosity and persistence, making them more willing to explore ideas, take risks, and develop their creativity.

Children often struggle with idea generation and easily get stuck during creative tasks. These activities are too often reserved for the 'smarter' students, meaning many children engage with them less often. When they do, they tend to dismiss their ideas too quickly, out of fear of being wrong or because their ideas need to be realistic.

This points to a lack of creative confidence, which helps to think and act creatively. Confidence grows through practice, so the more children engage in creative tasks, the more confident and creative they become. To enable this growth and keep doing creative tasks often, children need to be intrinsically motivated, driven by interest and curiosity while enjoying what they do.

### **Problem 3: Inconsistent understanding and support for creativity**

**Theory says:** Creativity is a dynamic, contextual process, shaped by social, cognitive, and environmental factors, and should be intentionally supported. Teachers, therefore, need to act as guides and facilitators, grounded in a clear understanding of what creativity entails.

**Practice shows:** Teachers interpret and support creativity very differently, often without shared frameworks or clear goals. Because of a lack in knowledge, teachers rely heavily on intuition or "ready-made" activities, which may not align with children's creative development.

**Tension:** While literature emphasizes the importance of contextual support and having knowledge, in reality, support is inconsistent and ad hoc, which undermines both children's development and teachers' confidence.

**Why it matters:** When teachers lack clarity and support, they cannot step into the role of facilitators who nurture process-oriented creativity. Instead, they remain constrained by what they personally know, and think is right. This not only limits children's creative growth but also reduces teachers' own sense of agency and confidence in shaping environments where creativity is supported.

Many schools lack a clear understanding of what creativity actually is, why it matters, and how often it should be practiced. Without this foundational knowledge, creativity is rarely prioritized in school culture. Teachers, in turn, often carry negative or vague associations with creativity, seeing it as chaotic, impractical, or disconnected from curricular goals. But this also extends to how they think about their students, such as the belief that creativity declines with age or is limited to a select few "gifted" students, which can limit their ability to nurture creative potential in all learners.

Teachers can play a transformative role in building students' creative confidence, but they need the right mindset and methods. By helping teachers gain knowledge on design and creativity, and supporting them to adopt new roles, such as coach, facilitator, and design thinker, we can enable them to actively shape learning environments that support creativity as a learnable, inclusive, and empowering process.

## 5.3 Reflecting with creative facilitation experts

To deepen the problem framing process and validate early insights, a creative session was held with a group of experienced creative facilitation experts. These four professionals specialize in guiding individuals and teams through creative processes, often using design thinking, visual thinking, and brainstorming techniques to unlock new perspectives and generate meaningful ideas. What unites them is a strong belief in the power of imagination, human potential, and the social value of creativity. Given their expertise in observing and supporting how people think and act creatively, they were especially well-suited to reflect on the topic of enhancing and supporting creativity. The specific sub-questions that were the focus of the session are: **'How do creative self-beliefs affect creativity in children?'** And **'what are enablers and obstacles to training problem-solving-oriented creativity in children within the classroom context?'**

The setup of the session is explained in figure 16.

### Planning

1 hour session with four creative facilitation experts

### Goals & Data to collect

The goal of the activity is to...	Data
Explore creativity within the 5 A's framework through real-life experiences with facilitating creativity and to together generate insights, tensions, and future design directions for building creative confidence.	Experience post-its, experiences mapped on the 5 A's framework, idea post-its from brainstorm, recording of conversation

Figure 16.a. Setup of the creative facilitation experts session.

### Activities

1. The session started with recalling personal experiences with guiding and observing people in doing creative exercises.
2. Sharing and mapping of the experiences on the 5 A's of Creativity framework to further analyse.
3. Discussion on the most interesting tensions and patterns.
4. Short brainstorming exercise based on the most relevant findings on the framework served as a springboard for the ideation phase, which will be further explained in Chapter 6.2.

Figure 16.b. Setup of the creative facilitation experts session.

### 5.3.1 Findings of the session

To move from the personal experiences to finding tensions and patterns, the experts voted for what they thought would be interesting opportunities for improvement.



Six topics were highlighted:

1. There is a variety of personal style and preferences that need to be targeted
2. Openness to fail
3. Doubt tends to be present (Thoughts like "This idea sucks")
4. Children can get confused
5. Playing with an outcome (instead of just focussing on one final outcome)
6. (Growing in creative confidence) After a breakthrough



Figure 17. Key problems topics

In the discussions, the experts elaborated on their insights and the highlighted topics. A central theme was the presence of doubt and fear of failure. Rather than removing doubt, they emphasized normalizing failure as part of the process and creating a space where “something doesn’t have to be good yet” helps children feel safe to begin. They also mentioned the importance of a process-focused mindset and highlighted the need to postpone judgment and make room to do it wrong. Also, the material (physical space) and immaterial (feeling it creates) atmosphere of the space plays a key role in shaping how freely children create.

In terms of guidance, children often need a small starter to begin, but too many instructions can be overwhelming. One participant explained: “If you tell too much or explain too many steps ... they don’t want to do it. But if you guide them step by step, that is powerful.” This gradual approach helps to “slowly get the big wheel rolling.” However, the use of examples can have the opposite effect and block children’s creativity. Also, supporting children in discovering their own styles through a variety of creative activities (e.g. building, imagination, roleplay) helps them grow in confidence.

A final reflection concerned the role of the facilitator within the 5 A’s framework, which may not be the right framework to capture the facilitator’s role. A creativity facilitator is not only a passive audience, but an active shaper of the creative environment, playing a role across audience, action, and affordances.

*The results of the second part of from this session (brainstorm results) will be shared in the next chapter.*

## Key findings

### How do creative self-beliefs affect creativity in children?

- Normalize doubt and failure to lower creative barriers. Doubt is a natural part of the creative process. Creating a space where it’s safe to fail and where things “don’t have to be good yet” helps children get started and stay engaged.
- Support diverse creative styles and preferences. Offering a variety of activities and tailoring these activities allows children to explore different ways of creating and helps build their confidence and personal expression.

### What are enablers and obstacles to training problem-solving-oriented creativity in children within the classroom context?

- Balance structure and freedom in guidance. Children need clear, step-by-step instructions to avoid confusion, but too much guidance, or relying on examples, can limit creativity. A gradual, open approach supports autonomy and flow.
- Focus on process over outcome. Creativity thrives when attention shifts from perfect end results to exploration, iteration, and playful experimentation.

### 5.3.2 Problem framing validation

Reflecting on the refined problems in light of the expert session provides clear confirmation and nuance to the framing.

#### Problem 1: Result-driven culture in schools restricts the creative process

Experts strongly reinforced that creativity depends on a process-focused mindset where exploration, iteration, and reframing failure are central. They highlighted the importance of “postponing judgment” and creating spaces where “it doesn’t have to be good yet.” This directly contrasts with the product-focused culture present in schools, where efficiency and correctness dominate. The experts emphasis on atmosphere, both tangible and intangible, further underscores how strongly the surrounding culture shapes children’s willingness to create.

#### Problem 2: Creative confidence is both the prerequisite and the result of creative engagement, leaving children caught in a cycle of hesitation

The experts identified doubt and fear of failure as a natural but critical barrier. Rather than trying to eliminate doubt, they stressed the need to normalize failure and treat it as part of the creative process. Safe, gradual guidance (“slowly get the big wheel rolling”) and varied activities were described as effective ways to lower barriers and build confidence. At the same time, they warned that overly detailed instructions or fixed examples can hinder children’s initiative, reinforcing the tension between needing support and maintaining freedom.

#### Problem 3: Inconsistent understanding and support for creativity

The session also revealed that the facilitator’s role is more complex than the 5 A’s framework captures. Teachers are not just passive audiences but active shapers of creative environments who balance structure and openness, while fostering autonomy. They also require an understanding of how to balance structure and freedom when guiding creative activities. This includes offering step-by-step support when necessary, while avoiding excessive instruction or reliance on examples, in order to maintain children’s autonomy and creative flow.

Taken together, the expert input validates the three refined problems and points to opportunities for change.

## 5.4 Design Focus

Moving from the problem framing to the design focus, the key directions now become clear. The original aim was to extend the Your Turn toolkit with new design tools. In light of the identified problems, this extension will focus on creating opportunities for children to engage more openly in creative activities, build confidence (problem 2), and shift their attention from outcomes to process (problem 1)

At the same time, the research revealed a deeper foundational issue as well, namely the lack of a shared understanding of creativity and insufficient teacher support (problem 3). The role of teachers as creativity enablers remains an important consideration, informing the Research through Design activities and will be revisited in Chapter 7.

These insights inform the emerging design focus: shifting from outcome-driven activities to process-oriented experiences that build creative confidence, and support both teachers and students.

The final design challenge is therefore framed as follows:

**How might we help 9–12-year-old children shift their focus from the end result to the creative process, in order to foster creative confidence, while also supporting teachers in understanding and facilitating this shift?**

The design question is intentionally two-sided, as it targets the children's experience, while also acknowledging the crucial supporting role of teachers. At the same time, is it important to recognize that the intentional focus on the process can create the impression that the final ideas are merely a secondary outcome. However, the aim of idea generation and creativity is still to produce ideas that are both novel and useful, contributing meaningfully to the design process.

This paradox points to both the opportunities and the risks of emphasizing process. On the one hand, an emphasis on the process carries the risk of generating ideas that are not useful or impossible to implement. On the other hand, prioritizing the process helps children to lower creative barriers, develop their design skills without the pressure of doing it 'right', and gain experience, fostering their creative confidence and ultimately leading to richer idea generation. During the Research through Design (RtD) process, special attention was paid to whether the children's ideas remain applicable and valuable, even when they are not explicitly aiming to produce 'perfect' outcomes.





# sessions at schools

- 6.1 introduction
- 6.2 concept designs for RtD activities
- 6.3 creative confidence workshop
- 6.4 design lesson at schools
- 6.5 conclusion

In Chapter 6, the sessions at schools are presented, following a Research through Design approach. It covers multiple workshops and lessons with children, which aim to explore their engagement with design tasks, their ways of expressing ideas, and the development of creative confidence.

# 6.1 Introduction

## 6.1.1 Research through Design

In developing educational materials for children, a key objective was to employ a process that simultaneously produced design outcomes and new insights into how children engage with creativity. For this reason, the project was guided by the principles of Research through Design (RtD). As explained in Chapter 2, RtD treats design activities themselves as a means of inquiry: through framing challenges, iterative prototyping, and engaging with stakeholders, new insights are produced (Stappers & Giaccardi, 2014).

This approach is particularly valuable in the context of this project. By embedding the design process within real classroom settings, RtD allowed ideas to be explored, tested, and refined while simultaneously deepening understanding of the teaching context and children's creative development. In practice, this meant that children were active participants in the process and their involvement made it possible to observe creativity as it unfolded.

Three different types of activities were organized following the RtD approach: an initial workshop, multiple workshops to analyse creative confidence and lastly design lessons.

All the activities were led by the design question introduced in the previous chapter. At the same time, the insights gathered also contribute to addressing the broader research question:

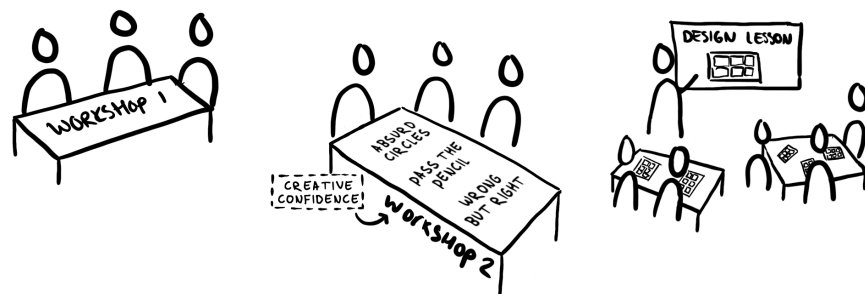


Figure 18. Overview of type of RtD activities

'How is creativity supported during the idea generation phase among primary school children aged 9 to 12?'

## 6.1.2 Preparing for design sessions with kids

Before fully engaging with children in the design process, an initial workshop was held to explore how they interact with design tasks, respond to design questions, and work with different methods. It also served to test practical aspects such as the materials needed and the timing of exercises. The set-up of these sessions was guided by insights from the course Co-creation with Youth (Gielen & Vegt, 2024), which provided a helpful reference for involving children in workshop-based design activities.

### Workshop setup

The workshop starts with a short icebreaker activity, which invites kids to draw scribbles and turn them into birds (scribble birds), to help them get into the mindset of drawing and dismiss perfectionism. Next, an initial idea generation brainstorm is held based on a given design question, to help kids get familiar with thinking of ideas and to see how they approach ideation without any help. Since the children were about to go on school camp, the design questions were all camp-related to make the activity fun, interesting, and relevant to them, to spark their curiosity and motivation. Examples of the design questions are: 'Design something that makes it easier to carry your heavy bags to the camp location' and 'Design something that makes doing the dishes at camp more fun for everyone'.

In the next activity, new elements were introduced in steps to support divergent thinking and deeper exploration. The first of these was a set of "Take a Different Look" cards, followed by explorative questions inspired by Howard-Jones (2002). They then could choose to apply imaginary tools, such as a hammer or scissors to their current designs, and lastly, they could use other creative techniques based on the research of Sun et al. (2020) (e.g. association and combination).

From the start, a set of mystery object cards containing images of random objects (like a sock or rubber band) was placed on the table. If the kids dared to pick a mystery object card, they were required to include the object in a new idea, adding a layer of challenge intended to stimulate unexpected connections and imaginative solutions. The full design game, including all materials and cards, can be found in Appendix G. The setup of the session is explained in figure 18.

## Planning

30 minutes per group, two groups with each 4 children from group 8

## Goals & Data to collect

The goal of the activity is to...		Data
See how children tackle idea generation		Observing: Where do they get stuck + ideas on paper
Gather input on how to create the tool	Do the kids understand how to use the mini-tools	Observing: What do they try, where do they get stuck
	Are they using the tools as expected	Observing: What do they try, + ideas on paper
	Does it help them think of more ideas than without the tools	Number of ideas within given time
Co-create the tool to what works for them	Do they feel confident using the tools	Qualitative feedback through conversation
	Do they like using the tools	
	What obstacles did they face	Observing: Where do they get stuck, ideas on paper, qualitative feedback
	What would they change	Qualitative feedback through conversation

Figure 19.a. Setup of the first workshop with kids

## Activities

1. Introduction: Icebreaker activity to help start drawing
2. Ideate without tools: Think of ideas for a design problem without help
3. Design game with mini tools: Try out and use the mini-tools to think of ideas & draw/write/say out loud
4. Evaluate experience: Evaluate the tool based on their own experiences, are they confident, do they get stuck, do they like using it, does it feel playful
5. Improve tool: Evaluate the tool based on the results and ease of use

Figure 19.b. Setup of the first workshop with kids

## 6.1.3 Personal reflection & findings

The first point of reflection is that the session had too many goals packed into a limited timeframe. Especially as I took on the role of both facilitator and observer, where I was managing the timing, guiding the children through the activities, and trying to note their reactions. This dual role was a bit challenging. While I was able to maintain the flow of the workshop, it left little capacity to conduct in-depth observation or record spontaneous behaviours and comments. In hindsight, having a second person present, focused on observation and note-taking, would have been very helpful.

At the end of the session, I asked the children to explain their final ideas and how these related to the design question from the beginning. Surprisingly, most of the children had forgotten about the original design question altogether. Although the creative prompts, especially the mystery objects and explorative question cards, were effective in encouraging imaginative and divergent thinking, they also may have shifted the children's focus away from the central design challenge.

This showed how important it is to keep reminding the kids of the design question during the process, but also to keep tasks simple so they're not having to focus on too many things at once.





Figure 20. Setup of the first workshop with kids

Even though the initial goal of this workshop was not to use the actual design outcomes in the continuation of the project, there are some interesting findings.

Firstly, the mystery object cards were especially well-received. The children described enjoying the element of surprise, and even though some objects were difficult to incorporate, they consistently found ways to adapt and include them.

"I didn't have many ideas so I often had to pick a card."

When asked what helped with generating ideas, someone pointed to a card with mystery objects:

"This one for sure, it was so random that you had to come up with something new."

This suggests that the mystery objects were successful in pushing their creativity and problem-solving skills. The explorative questions also had a strong impact on idea development, helping children move beyond their initial concepts. However, the children were less inclined to choose these cards on their own, so I occasionally handed them out to stimulate their thinking.

The design activity did help them move away from their initial ideas and the end result was surprising for many, as one child said:

"I really have no idea how I came up with a robot"

These findings will directly inform the design of the next workshops and lessons. I plan to reduce the number of activities to allow more time for reflection and using the actual design (tool). A second facilitator or observer will be included to ensure both smooth facilitation and more complete and accurate documentation. To maintain focus on the design question, I will keep the prompt visible throughout the session and build in brief checkpoints to return to it.

## Key findings

What are enablers and obstacles to training problem-solving-oriented creativity in children within the classroom context?

- Children had forgotten the design question during idea generation, which shows that the ongoing reflection is key.
- Don't overcomplicate the activities, keeping things simple helps with clarity and focus.

## 6.2 Concept designs for RtD activities

To carry out the RtD approach, new design tools were created to guide the activities. The first ideas for design tools were extracted from the brainstorm session with the creative facilitation experts. Next, with those ideas in mind a couple of idea generation rounds were done to find come initial ideas to start testing with kids.

### 6.2.1 Creative facilitation experts brainstorm

As described in Chapter 5, the session with creative facilitation experts began with a mapping and ranking of possible problem areas. Building on this, during the same session the experts engaged in a rapid ideation brainstorm on tools and techniques that could help children build creative confidence.

These problem areas were closely related to the design question and focused on normalizing failure, emphasizing the process, and creating space for different creative styles.

#### Brainstorm ideas

During the workshop, the experts generated a series of ideas and reflections on how to nurture creative confidence. These ideas were not meant to have one single outcome, but to open up many different directions that together open up possibilities for new design tools.

Key themes from the problem framing earlier in the session were the invitation to allow for exploration, actively shutting the doubts and being open to fail. Linked to this, was suggested that doing action forward helps create intentions and understanding the why, by moving, trying, and making, clarity emerges.

The first idea was that the act of creation or ideation can already be prototyping. In this way, every attempt is meaningful, and the process itself carries value. This can be elaborated into the suggestion to make use of the physical space, letting the environment become part

of the creative process, but also to allow the expression of creativity in children's own preference styles. Alongside this, there was an emphasis on making room for all different talents and modes of creative expression, ensuring that diverse ways of being creative are validated and supported.

Ownership also came forward: participants highlighted the value of creating ownership of the problems so that individuals feel personally engaged.

The final comments further extended these inspirations. Participants observed that practising what creativity is and how it can help you personally can support motivation and engagement. They also stressed the value of explicitly explaining what the kids are doing and what is actually happening, so that the creative process becomes visible and understood.

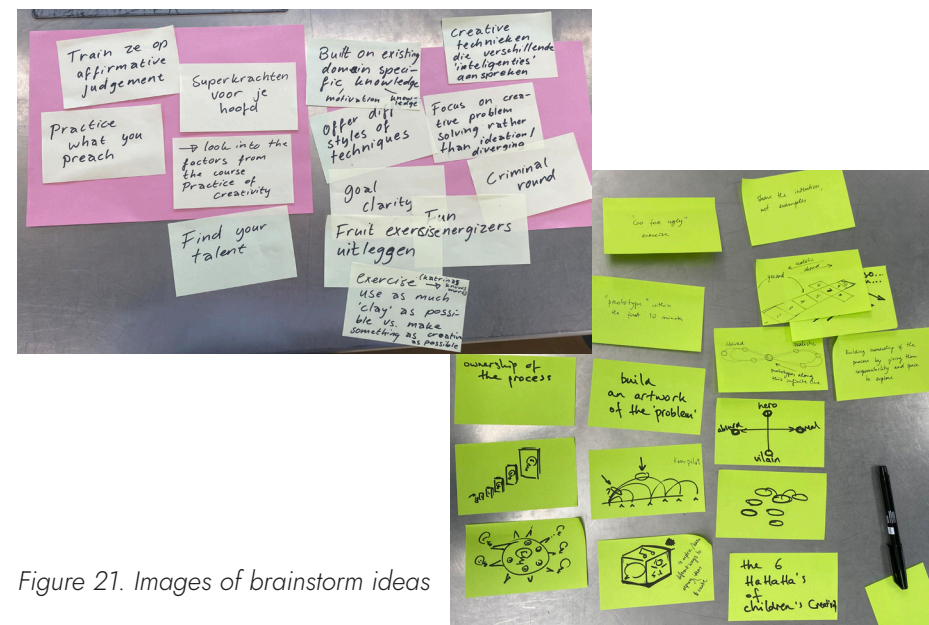



Figure 21. Images of brainstorm ideas



## 6.2.2 Further idea generation

For the initial idea generation for tools to use in the RtD activities, multiple ideation tools (including from the Delft Design Guide (Van Boeijen et al., 2020)) were used, like mind mapping, HKJ's, 'What if' questions and Five Why's.

Next, combined with the inspiration from creative facilitator experts, 3 initial concepts were chosen. To allow for broad variations in ideas for the testing with kids, the concepts were chosen to be different in expression (talk/draw), how to think divergently (specifically absurd or not), individual or group, thinking in silence or out loud, etc.

The chosen concepts were Absurd Circles, Pass the Pencil and Wrong but Right. These ideas were chosen based on the expected alignment with the design requirements (as indicated by the icons), which had not yet been fully formalized at this point, and guided by intuition  my personal experience in generating ideas.

## 6.2.3 Concepts for the next workshop

### Absurd Circles (concept 1)

Goal:

- Encourage children to let go of their usual "reality-checks" and generate wild, unexpected ideas.
- Highlight the value of building on each other's thoughts, even when they seem random or disconnected.

Step-by-step:

1. All kids stand in a circle.
2. One child starts by sharing an idea for the design question (DQ).
3. The child on their right makes the idea more absurd or crazy.
4. Continue around the circle for two rounds, each time exaggerating or twisting the idea further.
5. After two rounds, switch to the "reality lens": now, each child (starting on the left side of the original speaker) makes their neighbour's idea more realistic.
6. After one round of reality-checking, switch back to the absurd lens.
7. Alternate between absurd and realistic rounds until you decide to stop.

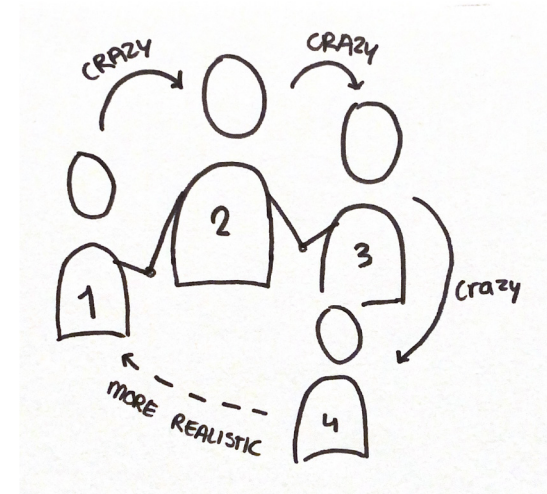


Figure 22. Visualization of Absurd Circles

### Pass the Pencil (concept 2)

Goal:

- Show how ideas can evolve and transform step by step into something unexpected.
- Explicitly emphasize the value of the process itself, not just the final outcome

Step-by-step:

1. The first child draws an idea for the given DQ on a card.
2. Without speaking, the next child interprets the drawing and thinks of a new idea and draws it on the next card (tip: they can use associations if they get stuck).
3. Continue passing the cards around, with each child adding a new drawing to a card based on the previous one.
4. When everyone has contributed, each child explains what they drew and why.
5. Together, reflect: does the last idea still address the DQ? If not, try redesigning it as a group.



Figure 23. Visualization of Pass the Pencil

### Wrong but Right (concept 3)

Goal:

- Encourage kids to consciously make mistakes and reframe them.
- Stimulate associative and creative thinking by breaking away from linear or structured problem-solving.

Step-by-step:

1. The first child asks a question.

*Example: "What is  $6 + 8$ ?"*

2. The second child gives an obviously wrong answer.

*Example: "Green."*

3. The third child explains why the "wrong" answer could actually be right.

*Example: "Trees have green leaves, and a tree has many parts, just like numbers add up."*

*Or:*

*"All even numbers are green and odd numbers are blue, so 'green' makes sense here."*

4. Switch roles until everyone has thought of and asked a question.



Figure 24. Visualization of Wrong but Right



## 6.3 Creative confidence workshop

The second round of workshops was designed to explore how children engage with creative concepts when the emphasis was placed on the process rather than the final product. During these sessions, individual behaviours and shifts in creative confidence were observed and assessed (through a questionnaire). This provided insight into how children's confidence shaped their overall creative engagement in the design activity, as creative confidence has been identified as a key factor in supporting creativity.

### 6.3.1 Evaluating creative confidence

Each workshop centred on one of the three concepts introduced earlier. The activities were structured to encourage idea generation while maintaining a focus on the process rather than on producing one 'perfect' outcome. During the activities, particular attention was given to creative confidence and to how the activities influenced its development.

To study creative confidence, children completed a short questionnaire before and after the design activity, where they rated their perceived creative skills with various statements on a 5-point Likert scale (1 = cannot do at all to 5 = highly certain can do). The questionnaire was based on the work of Ginns et al. (2023), who developed and validated a scale specifically designed to measure creative self-beliefs in children and adolescents. The questions and scales in the questionnaire of Ginns et al. (2023), are adapted from the original creative self-efficacy framework made for adults by Abbott (2010).

Since the workshops took place in Dutch-speaking schools, the questionnaire was translated from English to Dutch by the researcher and two fellow students. The translations were then compared and refined through discussion to ensure clarity and accuracy. A full list of the translated statements can be found in Appendix H.

Next to the questionnaire, the individual kids were observed while doing the activities to reflect. This was done to reflect with on the scores, and considered personality and active participation. Also, the general session was observed through an 'observation list', which contained indicators of active and enthusiastic engagement with the task, clarity of the activity, teamwork and thinking beyond their own first ideas and confidence in expressing ideas, all aimed to assess both the flow of the activities and how the activities were perceived. This list can be found in Appendix I.

The design questions used in the workshops came from Science Hub materials, to make sure they were age-appropriate and relevant. Some examples are:

How can you leave a secret message for someone that no one else can read? (Wetenschapsknooppunt TU Delft & ontwerp bureau Meeple, 2018)

How can you make new friends with someone who speaks a different language? (Wetenschapsknooppunt Zuid-Holland, TU Delft & ontwerp bureau Meeple, 2015)

How can you stay dry when cycling in the rain? (Wetenschapsknooppunt Zuid-Holland, TU Delft & ontwerp bureau Meeple, 2015)

The setup of the session is explained in figure 24.

## Planning

30 minutes per workshop. Two workshops with each 4 children per school, at 3 different schools (group 5, 6/7 and 8). So, 24 children across 6 workshops.

## Participants

School code	Group	Type of education	Class culture	Idea generating experience
School 1	Group 6/7	Traditional subject-based teaching	Strict structure, chaotic energy, individual tasks	Limited experience
School 2	Group 5	Traditional subject-based teaching	Strict structure, task focused, individual tasks	Limited experience
School 3	Group 8	Thematic teaching	Flexible structure, task focused, collaborative tasks	Some experience

## Goals & Data to collect

The goal of the activity is to...	Data
Gather feedback to improve or select the most effective tool for future use in the classroom	Frequency counted observations (of the group) based on list of behavioural indicators
To explore how three different design tools affect children's creative confidence	To explore how three different design tools affect children's creative confidence Form with creative confidence before & after using the design tool  Observations (specific for each child) on how they engage with the activity
Gather insights on how creativity is supported and influenced, with the goal of inspiring new tools	All of the above

Figure 25.a. Setup of the second workshop with kids

## Activities

1. Introduction: Why are we here today & energizer activity to help start drawing.
2. Creative confidence before: Fill out questionnaire about current perceived creative confidence.
3. Design activity: Generate ideas for given design question using the design tool.
4. Creative confidence after: Fill out questionnaire about perceived creative confidence after doing the design activity.
5. Evaluate experience: Shortly reflect on the workshop in the group.

Session	School 1	School 2	School 3	
1	Concept 2	Concept 3	Concept 1	Due to time constraints, only two sessions could be conducted at the schools, and the concepts covered were randomly assigned.
2	Concept 1	Concept 2	Concept 3	

Figure 25.b. Setup of the second workshop with kids

## 6.3.2 Workshop findings

### Findings: Design activity with concepts

The three design concepts each revealed different strengths and limitations in supporting children's creative engagement. The analysis not only highlights which tools show the most promise for future classroom use but also provides deeper insight into how creativity is shaped by the design context, the role of the teacher, and the children's interactions with one another.

### Concept 1: Absurd Circles

Absurd Circles showed strong potential for stimulating creativity, particularly when children were encouraged to make their ideas increasingly absurd. In some cases, thinking about more absurd or crazy ideas, increased the children's energy and willingness to share, though it also introduced more chaos in the classroom environment. Drawing their own ideas brought calmness and focus back to the group.

However, this concept required significant teacher guidance, and the teacher's interpretation of what is "realistic" could risk restricting the creative process. The quality of the design question was also highly influential: when the prompt was too abstract, ideas remained realistic; when it was grounded in children's everyday experiences (e.g., about staying dry in the rain), the results were far more imaginative. Finally, some children tended to generate new ideas independently rather than building on others' contributions, and when asked to make ideas "more realistic," they often resorted to deleting elements instead of transforming them.

### Concept 2: Pass the Pencil

Pass the Pencil was the most popular activity among the children and often generated the most varied and creative ideas. It was also the activity in which children expressed the most confidence in sharing their ideas. The structured, collaborative format contributed to this, but the rules introduced a complication: children asked many clarifying questions before starting the activity. This suggests that the rules at times distracted from the creative process.

Another limitation was the waiting time when others were thinking of a new idea, which occasionally disrupted focus. Separating the "thinking" and "drawing" stages proved important, as it allows children to reflect before acting and can help prevent them from getting stuck in the process. Overall, this concept balanced structure with creativity, but would benefit from simplification to make it more intuitive.

### Concept 3: Wrong but Right

The Wrong but Right activity was the least effective in supporting creative engagement. Although it occasionally prompted original and humorous ideas, most children struggled to understand its purpose. They were able to provide "wrong" answers but had difficulty reframing them into something meaningful. In many cases, children anticipated the "wrong" answer while still forming their questions, undermining the playful logic of the exercise. Observations also showed that children were almost twice as distracted during this activity compared with the other concepts, particularly among younger participants in group 5.

### Overarching Observations

Across all three concepts, several broader insights emerged. The environment played a crucial role: sessions held outdoors introduced more distractions, which particularly affected younger children, but also allowed for more expression. The design question itself strongly influenced engagement and outcomes; questions that were simple, relatable, and close to children's everyday world enabled greater exploration and creativity. Drawing was consistently mentioned by many children as enjoyable, and observations showed that students from groups 5 to 8 were generally willing to start drawing immediately, even when their ideas were very abstract. The workshop context, separate from school courses and free from grading or judgment, appeared to reduce pressure and allowed for playful exploration. Lastly, in some cases, children wanted to keep ideas they liked, such as the "home-work-machine," even if the idea was not very realistic. This highlights that the appeal of imaginative concepts alone can motivate engagement, but also shows that the judgement of children in converging needs guidance, for example by stating the goals and requirements more clearly at the start. This suggests that fostering creativity requires balancing encouragement of playful, imaginative ideas with opportunities to develop and refine them.



### Findings: Creative confidence

The measured creative confidence scores revealed differences across the three concepts. **Concept 1** (Absurd Circles) showed the largest relative increase, with an 8,5% rise from an average of 3,6 to 4,0 out of 5. **Concept 3** (Wrong but Right) demonstrated a smaller increase of 4,7%, but ended with the highest overall average (4,2 to 4,4). **Concept 2** (Pass the Pencil) showed the lowest growth, with a 6,0% increase from 3,3 to 3,6 (see figure 25). The analysis is however only based on descriptive statistics and no conclusions can be made on the effectiveness of the creative exercises from only these numbers.

Also, the scores do not fully capture the complexity of creative confidence during the sessions. Several moderating factors were observed. Children who were calm, concentrated, and able to understand the task generally achieved higher CF scores. Similarly, children with already high levels of creative confidence tended to be more enthusiastic and vocal, sometimes overshadowing peers with lower confidence.



When looking at the concepts individually, different results were seen. In **Concept 1**, children showed eagerness to engage, and as the activity encouraged increasingly absurd ideas, their participation and willingness to share grew, which is mirrored in the rise of creative confidence scores. In **Concept 2**, despite strong levels of understanding and motivation, the activity resulted in only limited growth in creative confidence, suggesting that the format was less effective in supporting confidence development. In **Concept 3**, children began with already high scores, leaving less room for improvement. Here, resistance to the task and a lack of motivation were noted, particularly among younger participants who became easily distracted.

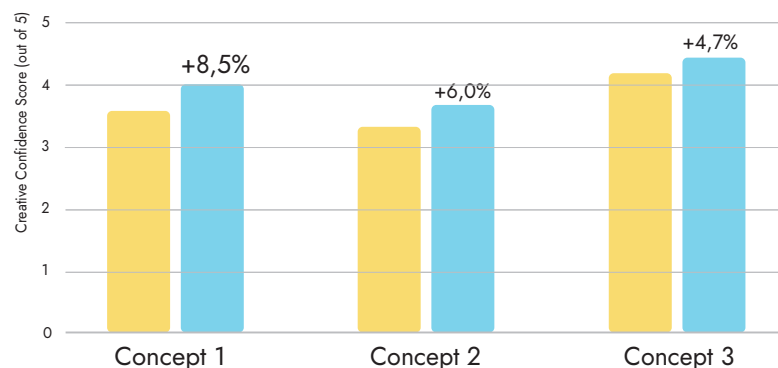


Figure 26. Change in creative confidence scores for all three concepts

### 6.3.3 Concept to continue the RtD activities with

Building on the workshop findings, this section reflects on the three tested concepts, Absurd Circles (Concept 1), Pass the Pencil (Concept 2), and Wrong but Right (Concept 3) and considers which concept shows the greatest potential to continue with in the final RtD activity. Each concept revealed distinct ways in which children engaged creatively and developed their confidence, providing a basis for selecting the most promising direction for further exploration.

#### Concept 1: Absurd Circles

This activity showed the strongest improvement in creative confidence, both in scores and in observed behaviour. Because the focus shifted away from the end product, new ideas emerged naturally and spontaneously.

#### Concept 2: Pass the Pencil

Pass the Pencil generated the most varied and imaginative ideas, and children often expressed that they found it enjoyable. The structured and collaborative nature of the activity encouraged confidence in sharing ideas. However, the format also created challenges: waiting times between turns reduced engagement, and the rules, while necessary, sometimes distracted from the creative process.

#### Concept 3: Wrong but Right

This concept occasionally helped children shift their thinking, and when it worked, it led to highly original and humorous ideas. Nevertheless, most children struggled to understand the purpose of the exercise, found it difficult to produce “wrong” answers with “right” explanations, and were easily distracted as a result.

### Conclusion and Design Implications

The next stage of tool development will combine the strengths of the first two concepts. A Pass the Pencil format will be retained, but adapted with the playful and absurd elements of Absurd Circles, to build on the concept’s strong boost to creative confidence.

Adjustments will include: clearer rules supported by examples, guided exploratory questions to stimulate absurd thinking, and explicit

clarification that realism does not mean deletion.

To reduce waiting times, all children will contribute ideas simultaneously, with the teacher guiding initial reflection before drawing begins. This hybrid format is expected to strengthen both creative confidence and idea generation in classroom settings.

## Key findings

### How do creative self-beliefs affect creativity in children?

- Creative confidence grows when focus shifts away from end product
- Children who were calm, concentrated, and understood the task generally scored higher in creative confidence. This confirms that active engagement has a positive impact on creative confidence.

### What are enablers and obstacles to training problem-solving-oriented creativity in children within the classroom context?

- 'Pass the Pencil' showed that collaboration and imagination led to enjoyment of the task, but complex rules and waiting times disrupted engagement
- 'Wrong but Right' confused most children, reemphasizing the need for simple, clear, and straightforward activities
- The formulation and topic of the design question play a decisive role in shaping children's creative engagement and outcomes

## 6.3.4 The 'Draai Door' tool

The design tool 'Draai Door' (English version: 'Spin Around') is developed to help children experience how ideas evolve through collaboration. The central principle is that ideas can be transformed when shared, alternately becoming more imaginative or more realistic. By passing on drawings and interpreting each other's ideas, children are encouraged to recognize that creativity is not about creating one perfect idea, but it is a process in which ideas continuously evolve, expand, and transform through interaction, which connects to the problems from the previous chapter.

The activity stimulates divergent and convergent thinking in a playful manner: first by exaggerating ideas in unexpected and absurd directions, and then by adapting them towards more feasible solutions. In doing so, pupils gain insight into the dynamic nature of creativity and learn to reflect on how collective contributions influence the development of ideas. This activity not only stimulates creativity, but also teaches pupils to look at ideas from multiple perspectives, to embrace unexpected twists, and to reflect on how creativity arises in interaction with others. It is designed to make the creative process both tangible and fun, while encouraging group dynamics and fun along the way.

The core objective of the tool is to let children experience how ideas can grow and change through collaboration and learn to better understand the creative process.

### How it works

#### Introduction of the rules

The teacher explains the assignment and clarifies the difference between "crazy" and "realistic" thinking, using examples if necessary. Make sure the children understand what "realistic" means in this context.

#### First idea

Each child thinks of and draws an initial idea on the worksheet in silence.

#### Making it absurd

Children pass their sheet to the left. Everyone looks at the drawing they receive, interprets it in their own way, and adds a crazier idea next to it. The passing and drawing continue until everyone has their own sheet back.

#### Group reflection

The children briefly discuss in their groups: What was your first idea? What did others add? Which additions were the most surprising or funny?

#### Making it realistic

Sheets are passed again, but this time adapt the idea to make it more realistic. The challenge is to think about how the crazy idea could work but in reality, not to just simplify it and delete elements. Repeat until no new ideas emerge. Then either start with a new idea or close the activity.

## 6.4 Design lessons at schools

After conducting the smaller, exploratory sessions (workshop 1) with one group of children at a time, the next step was to test the design activity in a larger realistic classroom setting. The real-life classroom setting was chosen to see how the refined concept would function as part of a complete design lesson. It also offered an opportunity to observe how the lesson, and the potential for enhancing creativity, would play out within the everyday structure and dynamics of a typical classroom, where neither the teacher nor the students had prior experience with design activities.

Unlike the earlier sessions that focused solely on the children, the teachers were also actively involved in the lesson. Their role was on the one hand to prepare and teach the lesson, but also to reflect on the activity alignment with their existing teaching practices. Combined with observations of the lesson, this helped address the second part of the design question, to support teachers in understanding and facilitating the shift in focus from the end result to the creative process and within doing that to nurture the children's creative confidence.

At the same time, the lessons served a broader purpose: it offered a valuable window into the day-to-day reality of the classroom. Observing the teacher, students, and environment in action provided deeper insights into classroom culture, the dynamics of participation, and the conditions under which creative confidence can grow.

### 6.4.1 Used materials in the lesson

To support teachers in giving the lesson, two core materials were developed:

1. **A lesson guide**, which provided a detailed breakdown of the overall session, including the sequence of activities and additional background information on creativity and design.
2. **A design tools booklet**, which explained each individual activity in a clear, step-by-step format to make it easy for teachers to understand and implement.

One key insight that emerged from the earlier workshops was that overly complex or misaligned design questions often hindered the ideation process. To avoid this issue, an existing design question and lesson structure from Your Turn was used as the foundation for this session, namely the first lesson of the design project '**Presenteer je gym-idee**'.

Specifically, three core components from the Your Turn format were kept the same:

- The design question,
- A story used to introduce the design challenge, and
- The "Kies je vak" (choose your subject) exercise.

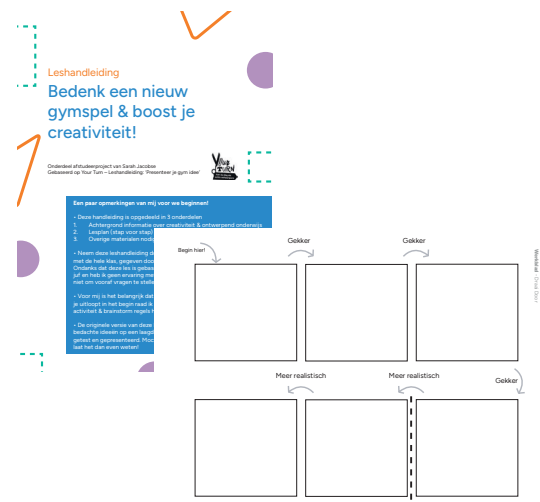
Several modifications were made to adapt the lesson for this pilot:

- A more comprehensive introduction to design was included for teachers, ensuring they understood the background and purpose of the activity.
- An icebreaker activity was added at the start to help students shift into a creative, process-oriented mindset and get used to drawing.
- The main design activity, "Draai Door," was introduced as the core of the lesson, as the main idea generation activity.
- Finally, a set of reflection questions was added at the end to talk with the children about their experiences and results.



The full lesson guide and design tools booklet, including ‘Draai Door’ can be found in Appendix J.

Both materials were evaluated with a primary school teacher (who was not part of the participating schools). The aim was to assess whether the lesson was clearly communicated, suitable for teachers, and executable from the perspective of someone with no prior background on the topic.



Planning

30 minutes per workshop. Two workshops with each 4 children per school, at 3 different schools (group 5, 6/7 and 8). So, 24 children across 6 workshops.

Participants

School code	Group	Type of education	Class culture	Experience
School 1	Group 6/7	Traditional subject-based teaching	Strict structure, chaotic energy, individual tasks	Limited experience
School 2	Group 5	Traditional subject-based teaching	Strict structure, task focused, individual tasks	Limited experience
School 3	Group 8	Thematic teaching	Flexible structure, task focused, collaborative tasks	Some experience
School 4	Group 7	Traditional subject-based teaching	Strict structure, chaotic energy, individual tasks	Some experience

Figure 27.a. Setup of the design lesson

Goals & Data to collect

The goal of the activity is to...	Data
Evaluate whether the lesson set-up and design tool successfully encouraged students to value the process over the final project outcome	Drawings of the kids on template, collected per group Observing: how did kids tackle the activities Qualitative feedback through conversation with children
Analyse if and how the teachers actively support creativity	Observing: how did the teacher give the lesson and use the lesson guide Evaluation conversation with teacher at end of the lesson Observing: flow of session
Gather insights on how creativity is supported and influenced, with the goal of inspiring new design tools beyond the ‘Draai Door’ method	All of the above

Activities

Before: Preparation of lesson by the teacher

- The lesson itself:
1. Introduction to design + icebreaker ‘Scribble birds’
  2. Discuss the design question
  3. Design tool: Choose your side
  4. Brainstorm rules
  5. Design tool: Draai Door
  6. Wrap-up & Feedback

After: Evaluation talk with teacher

The detailed lesson guide and design tools booklet, including ‘Draai Door’ can be found in Appendix J.

Figure 27.b. Setup of the design lesson

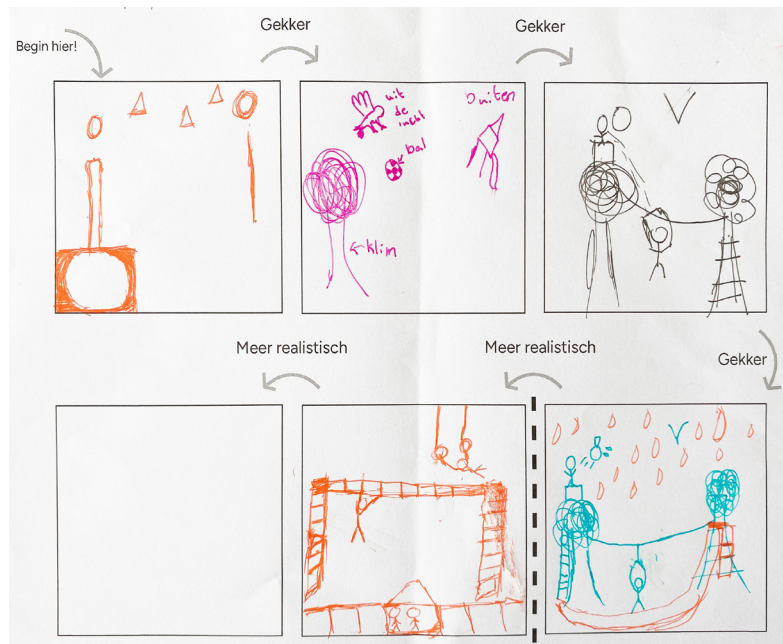


## 6.4.2 Findings: Process mindset

### Children's process mindset

Across the four schools, the lesson set-up and 'Draai Door' template often encouraged students to shift away from focusing on the final outcome and instead engage with the process of idea development. In nearly every group across all schools, the first and last ideas were visibly different. This suggests that students did not simply hold on to their initial ideas but pushed their thinking further and felt room for experimentation. This shift is apparent in examples like figure 26 and figure 27, where the drawings demonstrated a clear transition from creative to realistic interpretations and back.

Example of translating and interpreting someone else's idea



Good example of making an idea more realistic: the zipline becomes the rings and the trees become ladders

Figure 28. Example of drawing with Draai Door 1

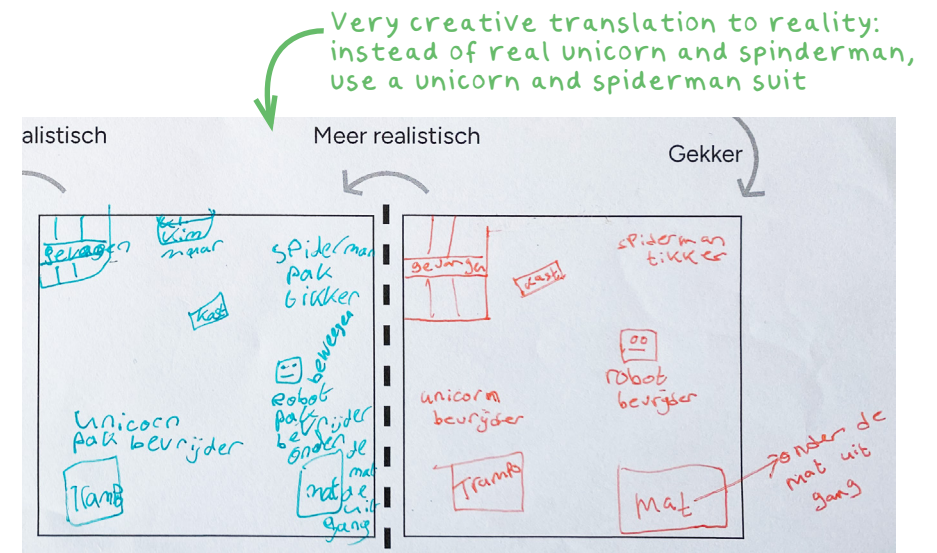


Figure 29. Example of drawing with Draai Door 1

### Ideation struggles and repetition

However, generating ideas was not always straightforward. In several cases, particularly in School 1 and School 2, students copied ideas from previous peers and did not seem to know how to build further, which led to repeated or very similar concepts in multiple boxes (e.g., figure 29). These moments highlight that generating ideas sometimes hits a limit, and students found it hard to add or transform an idea meaningfully, especially in terms of making something "crazier" or "more realistic." "I didn't know what to draw anymore, so I just stopped" (S1). Especially in younger kids (school 2), the term "realistic" was used very loosely (figure 28), where one kid defended the presence of a tiger in a school as plausible.



Figure 30. Example of drawing with Draai Door 4

"I didn't know what to draw anymore, so I just stopped"

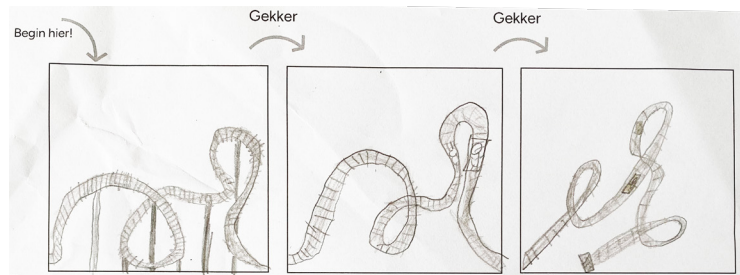


Figure 31. Example of drawing with Draai Door

This illustrates how the language used in the tool may need refinement, or extra support is needed to use this design tool.

The structure of the template itself also played a role in how students approached the activity. Many found the flow confusing, especially the transition from the top-right row to the bottom-right row, which resulted in drawings in the 'wrong' order (mostly at School 2).

At the same time, many students seemed to genuinely enjoy engaging with the process. A notable moment was when a group paused mid-activity and said,

"Alright, we can make this much more crazy!"

This spontaneous reflection showed that they were taking ownership of the process and starting to see it as a fun challenge. Another student said,

"I didn't expect the final idea to end up the way it did,"

showing surprise and delight in the outcome of their own process. However, some students struggled to articulate what ideas they had or how they changed the ideas of others, which might suggest that while transformation of ideas in the template occurred, awareness of the process was not always explicit.

In some cases, when kids were stuck, they looked around for inspiration, asked teammates, or thought of familiar materials like PE equipment, showing how inspiration and collaboration also supported the process.

### Focus on looks

While many children focused on developing new ideas, some gravitated toward perfectionism. Frequent use of erasers (School 1, 2 & 4) and the excitement about using colours (School 2) often shifted the focus from thinking about ideas to the appearance of the drawing. This shows that even though students were very engaged, they sometimes focused more on how their designs looked than on developing creative ideas behind them, especially when the teacher praised pretty drawings over original ideas.

## Key findings

### How is creativity supported during the idea generation phase among primary school children aged 9 to 12?

- Using the 'Draai Door' tool, students often moved away from their first ideas, showing engagement with the creative process.
- Confusion around 'crazy' and 'realistic' steps in the template sometimes led to idea stagnation or repetition.
- The flow of the 'Draai Door' template wasn't always intuitive, but still helped scaffold creative thinking.
- Peer input, familiar themes (like PE), and external cues supported idea development.
- Visual focus and perfectionism sometimes detracted from the process, especially when colour use was introduced and when students received more praise for pretty drawings than original ideas.

### 6.4.3 Findings: Teacher support

The lesson guide provided information on how to support creativity by explaining its meaning, the current 'wrong-right' culture in education, and ways to encourage exploration in children. The degree to which the four teachers used this knowledge during the lessons varied significantly, which had a clear impact on how students experienced the activity and interpreted the design goals.

#### Introducing creativity

In some schools, the teacher explained what design and creativity were and that the emphasis was to think in all directions, using phrases like "everything is possible" (e.g., School 1).

"Sometimes an idea is just not possible, but today everything is possible!" (School 2)

This kind of framing helped students start with a mindset open to exploration. However, even in these cases, students didn't always hold on to that message during the activity, suggesting that creative encouragement at the start needs reinforcement throughout the whole lesson. In other schools, creativity wasn't explicitly named at all. In School 3, for instance, the teacher simply called it "a research lesson" and dived straight into the task. This more neutral framing may have contributed to students engaging with it as a regular school exercise, rather than a playful or imaginative challenge.

#### Discoball phenomenon

The teachers supported creativity in their own way; some actively facilitated the process, while others stepped back during the activities. A key theme that emerged (schools 1 and 2) was the role of giving examples or inspiration.

One teacher (School 2) was very aware that students might copy any example handed to them. During the lesson, she shared a story about a different design question that included music and disco balls to illustrate a "crazier" idea. Unexpectedly, many students began drawing disco balls in their own designs. This surprised her, especially since she had intentionally avoided mentioning sports, because she feared

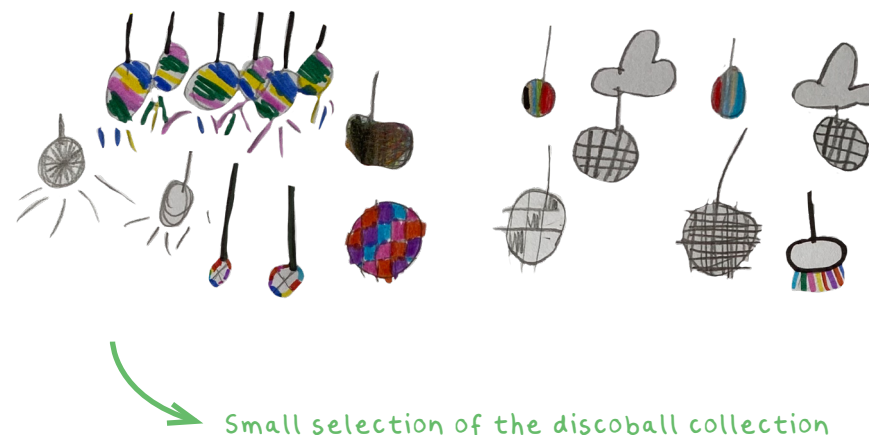


Figure 32. Discoball phenomenon

it might influence their ideas too heavily. This could be explained by the fact that the students didn't know where to start—and also that they weren't sure what a "crazy" idea could look like.

At school, 1 a similar thing happened, where the teacher gave examples of PE activities (gymnastics rings, football, basketball), and it resulted in students simply repeating those same examples for their first idea. However, a couple of steps after the first idea, they were able to think beyond the examples and generate more creative ideas.

#### Active reflection

In the lesson guide, it was mentioned to actively pause and reflect on the process, however this was not done except for school 4. In the lesson at school 4, the teacher actively facilitated class-wide reflection after each step, asking, "Why do you think we did this activity?" These kinds of questions gave students space to consider the purpose of the process and fostered a deeper understanding of creative practice. Meanwhile, in other schools, the process moved forward a group-reflection-like manner that (except for the previously mentioned group), leaving less opportunity to pause and internalize the value of iteration or creative thinking.





### Encouraging pretty over process

The praise of the teacher also shaped how creativity was supported. In several classrooms, teachers often gave compliments focused on aesthetic aspects: drawings were described as “cute,” “pretty,” or “realistic,” even when the goal was exploration and not judgement on drawing skills. This likely sent mixed signals about what was valued and may explain why some students prioritized neatness or beauty in their drawings.

### On-the-spot adjustments

Some teachers made on-the-spot adjustments to wording or activities to help the kids understand better. For example, most teachers changed the term ‘individual work’ to ‘working alone’ and many explained what ‘realistic’ meant, to make the task clearer for the children. In one case, when the scribble bird activity began to feel repetitive, the teacher (School 3) switched to scribble elephants, which helped the kids to think in a different direction again. These adjustments reflect how responsive teaching can support engagement of the children, especially when instructions are ambiguous or too abstract.

## Key findings

What are enablers and obstacles to training problem-solving-oriented creativity in children within the classroom context?

- Teachers who introduced creativity explicitly helped set the tone, but reinforcement and active reflection were needed throughout the session.
- Examples helped students understand open-ended goals better, but also risked limiting originality.
- Praise focused on appearance (e.g., “pretty” or “realistic”) risked misaligning with process-oriented goals.

## 6.4.4 Findings: Enhancing creativity beyond ‘Draai Door’

While the ‘Draai Door’ method introduced many students to creative thinking and led to varied new ideas, the lessons revealed how different factors shape and nurture creativity, offering inspiration for exploring new design tools.

### Expanding teacher support

One key observation was the variation in how teachers supported the creative process. While some encouraged exploration and open thinking, others unintentionally reinforced ‘product thinking’ by praising ideas as pretty or realistic. This seemed closely tied to teacher confidence and understanding of the activity. As one teacher reflected,

“I think if you teach the lesson yourself, the message would come across better. I think you’ll get a better result.” (School 1)

This highlights the need to not only support students but also empower teachers, especially those who may feel less confident in creative facilitation. Despite the lesson materials including an explanation of creativity and design, these few pages may not have offered enough depth or interest for all teachers to fully take it on board.

### When reality limits imagination

Another unexpected theme was the strict focus on reality. Students often toned down or abandoned original ideas when asked to make them more realistic, with many selecting the most practical concept as their favourites, which has been found before in the previously mentioned research on idea selection (Van Broekhoven et al., 2022). This preference for realistic ideas suggests a bias that can limit creativity even within activities designed to encourage it. The recurring prompt to consider what is realistic in the ‘Draai Door’ method, both verbally and on paper, may have constrained students’ thinking. There will always be a combination of divergent and convergent thoughts, but there may be value in finding ways for a new tool that aims for imaginative ideas in a way that postpones the judgement of it being realistic.





### Building Ideas Together

Collaboration also played a major role in shaping the creative process. The team interaction in classrooms where students were encouraged to brainstorm out loud or work together helped kids get unstuck and build on each other's ideas. One group at school 3 went into enthusiastic brainstorming even before they used the 'Draai Door' template, encouraging each other's ideas. In contrast, classrooms with strict rules around silence, such as School 2, let to students struggling to interpret drawings or extend other ideas. This sometimes led to repetition or misinterpretation. However, as the sessions progressed and ideas became more playful, even in these more controlled settings, students started to laugh, share, and enjoy the process more freely. This might suggest that a well-structured, playful design tool has the potential to gradually shift classroom norms.

### Expanding ways of expression

Finally, not all students expressed themselves best through drawing. Some acted out their ideas when words or visuals didn't come easily, while others grew frustrated or disengaged when they couldn't make something look perfect. A few became overly focused on making their drawings look pretty. These moments underscore the need for inclusive creative tools that support a range of expression styles, whether visual, verbal, or physical.

## Key findings

- The teacher's role emerged as central: their confidence, way of explaining and if they highlighted the purpose, strongly influenced how effectively creative processes unfolded, particularly for those less accustomed to facilitating open-ended exploration.
- The focus on making things realistic, may take away from free imagination.
- Collaborative formats created opportunities for students to build on one another's ideas, often leading to richer and more diverse outcomes, even within classrooms that typically operate under more rigid norms.
- Creativity was expressed through multiple modes, not only drawing; children also used movement, storytelling, and verbal contributions, highlighting the value of recognizing and supporting diverse forms of creative expression.

## 6.5 Conclusion

The figure below provides a visual summary of the main conclusions.

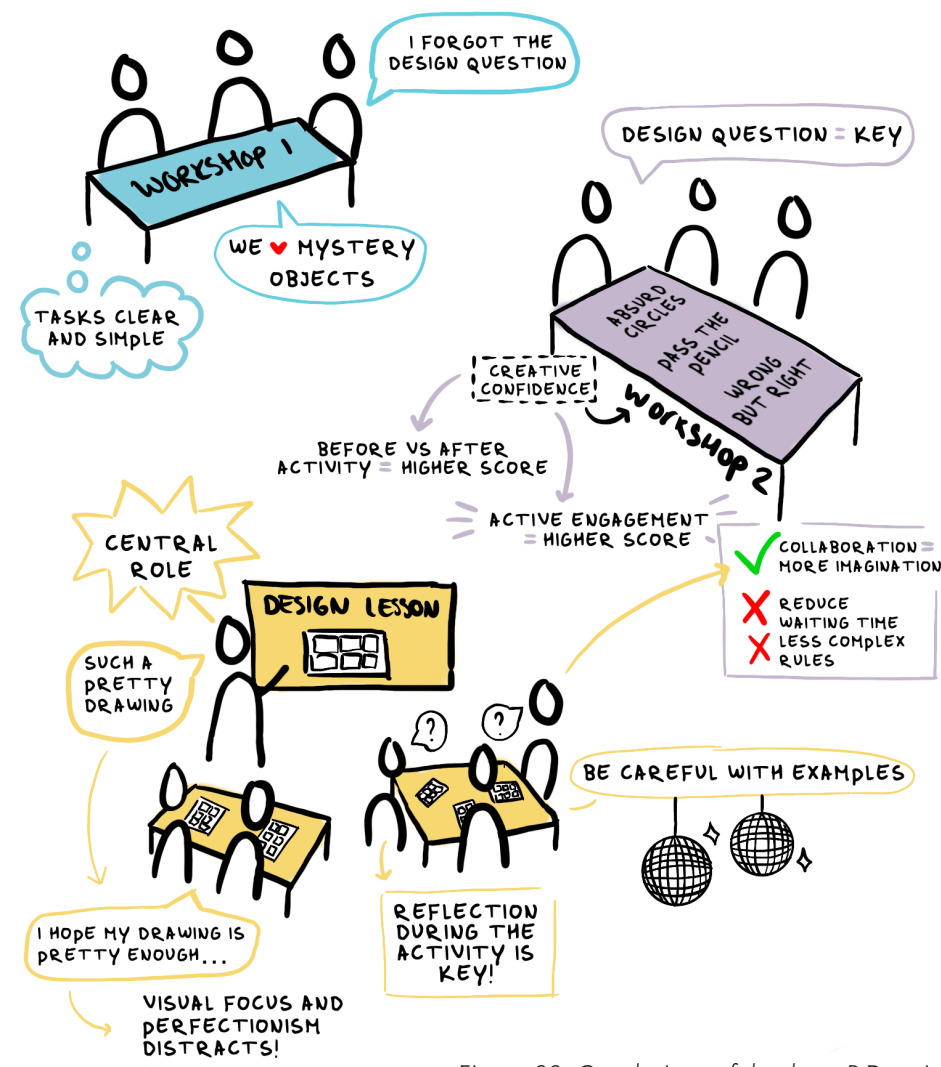


Figure 33. Conclusions of the three RfD activities



# refining the design challenge

7.1 looking back and moving forward

7.2 design requirements and conditions

This chapter refines the design direction established in chapter 5 by translating insights into actionable design requirements and broader design conditions that together guide the further development of the Your Turn toolkit.

## 7.1 Looking back and moving forward

In Chapter 5, the analysis of literature and contextual research identified three central problems that hinder creativity in supporting children during idea generation:

1. A result-driven school culture that restricts the creative process.
2. Children's struggles with confidence when generating ideas.
3. An inconsistent understanding and support for creativity among teachers.

These challenges led to the formulation of the following design question:

**"How might we help 9–12-year-old children shift their focus from the end result to the creative process, in order to foster creative confidence, while also supporting teachers in understanding and facilitating this shift?"**

This design question, together with the research question, 'How is creativity supported during the idea generation phase among primary school children aged 9 to 12?', guided the further 'Research through Design' explorations described in Chapter 6.

The RtD sessions at schools generated new insights and demonstrated the relevance of the design question. They showed that focusing on the creative process rather than the outcome provides a new and useful perspective for developing design tools. The ideas generated during the sessions demonstrated that even with an intentional focus on the process, children were still able to produce applicable and valuable outcomes, reinforcing the relevance of the design question as a guiding framework.

One concrete example is the Draai Door tool, which proved both engaging and enjoyable for children. This tool represents a promising first addition to the Your Turn toolkit.

At the same time, the findings emphasized the importance of looking beyond the three core problems.

From the literature research, context research and the RtD process, several key **requirements** emerged to guide the design of new tools. In addition, broader design **conditions** became visible. These conditions are elements that are essential for fostering creativity but lie outside the scope of specific idea generation tools as they mostly related to external factors and the teachers. Finally, throughout the research process, various inspiration **sparks** were collected. While not formal requirements, these sparks can be seen as potential requirements for individual tools rather than for the overall set. They offer rich, situational prompts for further tool development and can be found in Appendix K.

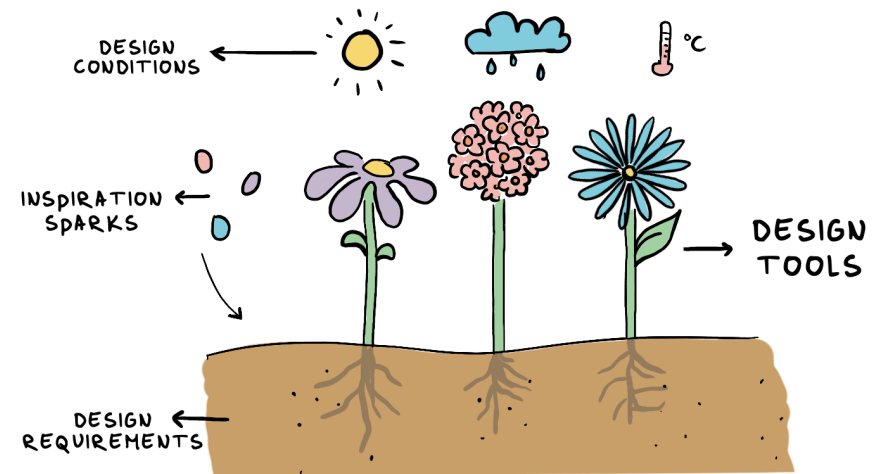


Figure 34. Difference between requirements, conditions and sparks

As illustrated in the visual, the requirements form the soil from which ideas grow, while the conditions act as the environment that supports this growth. The inspiration sparks are like seeds that can grow into individual tools.



## 7.2 Design requirements and conditions

**Design requirements** apply directly to tools for idea generation. They are intended to help focus on the creative process rather than the outcome. By embedding these aspects into the tools, they can be applied in everyday classroom settings with minimal preparation.

Each requirement and condition is explicitly linked back to the research findings it originates from. The following legenda is used to trace these connections, each reference shows the type of research and the section it can be found in: [Literature research \(LR\)](#) [Context research \(CR\)](#) [Research through Design \(RtD\)](#)

### ! 7.1.1 Design requirements

The design should...

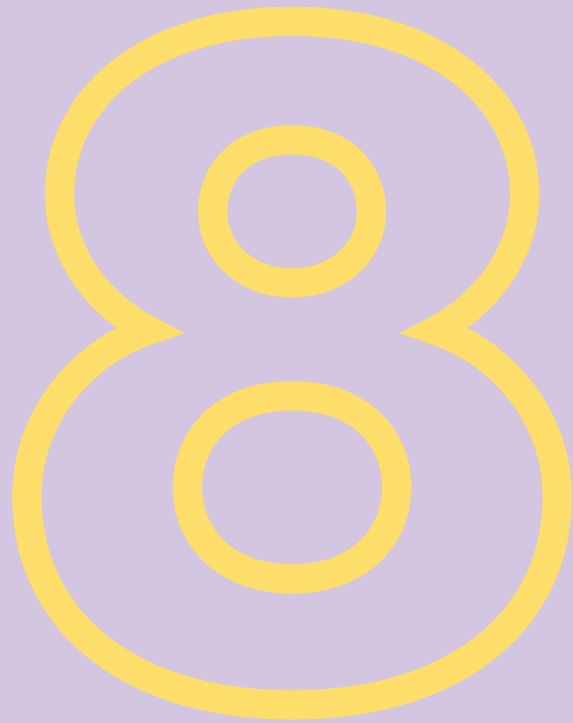
- 1 ... actively build creative confidence, by allowing for kids age 9-12 to be able to actively participate, in terms of their level of creative (expression) skills and knowledge (on topic).  
(LR, section 3.3) : (Beghetto & Karwowski, 2023; Atwood-Blaine et al., 2019; Amabile, 1983; Lewis, 2006; Looijenga, 2021; McGehee, 2022)  
(RtD, section 6.3)
- 2 ... encourage focus on the process rather than the outcome.  
(LR, section 3.6.1) : (Robinson, 2006)  
(CR, section 4.2 + 4.3)
- 3 ... be enjoyable, interesting and provoke curiosity, to spark intrinsic motivation.  
(LR, section 3.3 + 3.5.2): (Amabile, 1983; Hadini, 2015; Lewis, 2006)  
(RtD, section 6.3)
- 4 ... target imagination, flexibility, communication and collaboration.  
(LR, section 3.3.3): (Hadani, 2015)  
(RtD, section 6.4.3 + 6.4.4)
- 5 ... be simple and intuitive for both kids to do and teachers to facilitate  
(CR, section 4.2 + 4.3)  
(RtD, section 6.1.3 + 6.3 + 6.4.3)
- 6 ... include moments of reflection and pause to remember and refocus on the process, action and intentions  
(LR, section 3.3.3 + 3.4.3) : (Van Broekhoven et al., 2022, Klapwijk & Van Den Burg, 2019; Van Mechelen et al., 2015)  
(CR, section 4.3)  
(RtD, section 6.1.3 + 6.4.3)
- 7 ... actively help reduce fear of failure and judgement to encourage a brave environment.  
(LR, section 3.6.2) : (Lewis, 2006; Arao & Clemens, 2013; Stubbs, 2019)  
(CR, section 4.2 + 4.3)
- 8 ... indicate the level of experience with creative tasks needed  
(CR, section 4.3)
- 9 ... clearly explain the goal and value of the activity.  
(LR, section 3.6.2) : (Arao & Clemens, 2013)  
(RtD, section 6.3)

## 7.1.2 Design conditions



**Design conditions**, in contrast to the requirements, concern the broader environment in which creativity takes place, with particular attention to the role of the teacher. While they extend beyond the scope of individual tools, considering them opens possibilities for artifacts to connect with teaching practices.

- 1 Creativity and design activities gain value when their **meaning, relevance, and underlying intentions** are made clear to both teachers and children. (LR, section 3.4.1) : (Lewis, 2006)  
(CR, section 4.2 + 4.3)  
(RtD, section 6.4.4)
- 2 Teachers' **awareness of their own role and influence** is an important condition shaping how children engage with creative tasks. (LR, section 3.4.1): (Calavia et al., 2023; Lewis, 2006)  
(CR, section 4.3)  
(RtD, section 6.4.4)
- 3 Teachers' **recognition and valuing of the creativity of all children**, along with **awareness of their own biases**, strongly influence kids' creative confidence and engagement. (LR, section 3.4) : (Atwood-Blaine et al., 2019; Plucker et al., 2004; Bandura, 1997; Karwowski, 2022)  
(CR, section 4.2)
- 4 Creative exploration thrives in environments that provide **psychological safety and brave spaces**, allowing learners to take risks and express ideas openly. (LR, section 3.3.3 + 3.6.2) : (Edmondson, 1999; Stubbs, 2019)
- 5 Emphasizing **only visual outcomes** in feedback can **discourage** creative exploration, making giving **feedback on the process more valuable**. (LR, section 3.4.2) : (Beghetto et al., 2011)  
(CR, section 4.2)  
(RtD, section 6.4.2 + 6.4.3)
- 6 Open-ended and relevant **design questions** form a key condition for meaningful creative exploration and diverse idea directions. (LR, 3.6.2) : (Klapwijk, 2017)  
(RtD, section 6.3)
- 7 **Making learning goals explicit and reflecting** on their meaning throughout the creative process helps learners connect intention with outcome. (LR, section 3.3.3) : (Klapwijk & Van Den Burg, 2019)  
(CR, section 4.1 + 4.2)
- 8 Children benefit from **making their own design decisions**, which fosters ownership and engagement, but **guidance is necessary** to prevent them from choosing the most obvious or realistic choices. (LR, section 3.3.3) : (Klapwijk et al., 2021; Van Broekhoven et al., 2022)  
(RtD, section 6.4.4)
- 9 **Providing examples** can help children understand possibilities when design is new, but they can also constrain creativity if followed too rigidly. (CR, section 4.1)  
(RtD, section 6.4.3)



# shaping new ideas

8.1 idea generation for design tools

8.2 idea generation for teacher support

Chapter 8 develops and proposes new ideas that address the central design question. It introduces both design tools to support children in focusing on the creative process and supporting artifacts to help teachers facilitate this shift.

## 8.1 Idea generation for design tools

To start with the development of new design ideas for tools, it is useful to first recap the design question:

**"How might we help 9–12-year-old children shift their focus from the end result to the creative process, in order to foster creative confidence, while also supporting teachers in understanding and facilitating this shift?"**

In this section, the focus is primarily on the first part of the question, namely how to support children in valuing the creative process over the final outcome. With the design requirements in mind, a series of new ideas was generated, drawing inspiration from the previously found inspiration “sparks” that served as triggers for creativity (See Appendix K for the full list). The sparks offered startingpoints for new directions, while the design requirements proposed in Chapter 7 helped shape these ideas so they would truly support the shift from outcome to process.

### 8.1.1 Idea generation process

The ideation process, which started with the RtD activities, continued with a brainstorming session I carried out independently, structured around the sparks. This session produced a set of initial ideas, from which ten concrete directions were developed further. To assess the quality and relevance of these ideas, they were evaluated using a method comparable to a Harris Profile (Van Boeijen et al., 2020), which allowed for a systematic consideration of how well each idea met the predefined design requirements and which sparks it related to. The details of this evaluation can be found in Appendix L.

Following this first selection, a second round of refinement took place. During this stage, ideas with overlapping sparks were either combined or adapted to prevent redundancy and to ensure that the full range of sparks was represented across the final set of concept tools.

At the same time, unique ideas that did not yet fully align with the requirements were adapted to strengthen their fit, without losing their distinctive qualities. The overall goal of this process was to arrive at a set of concepts that each satisfied the requirements while being unique in the way they embodied specific sparks.

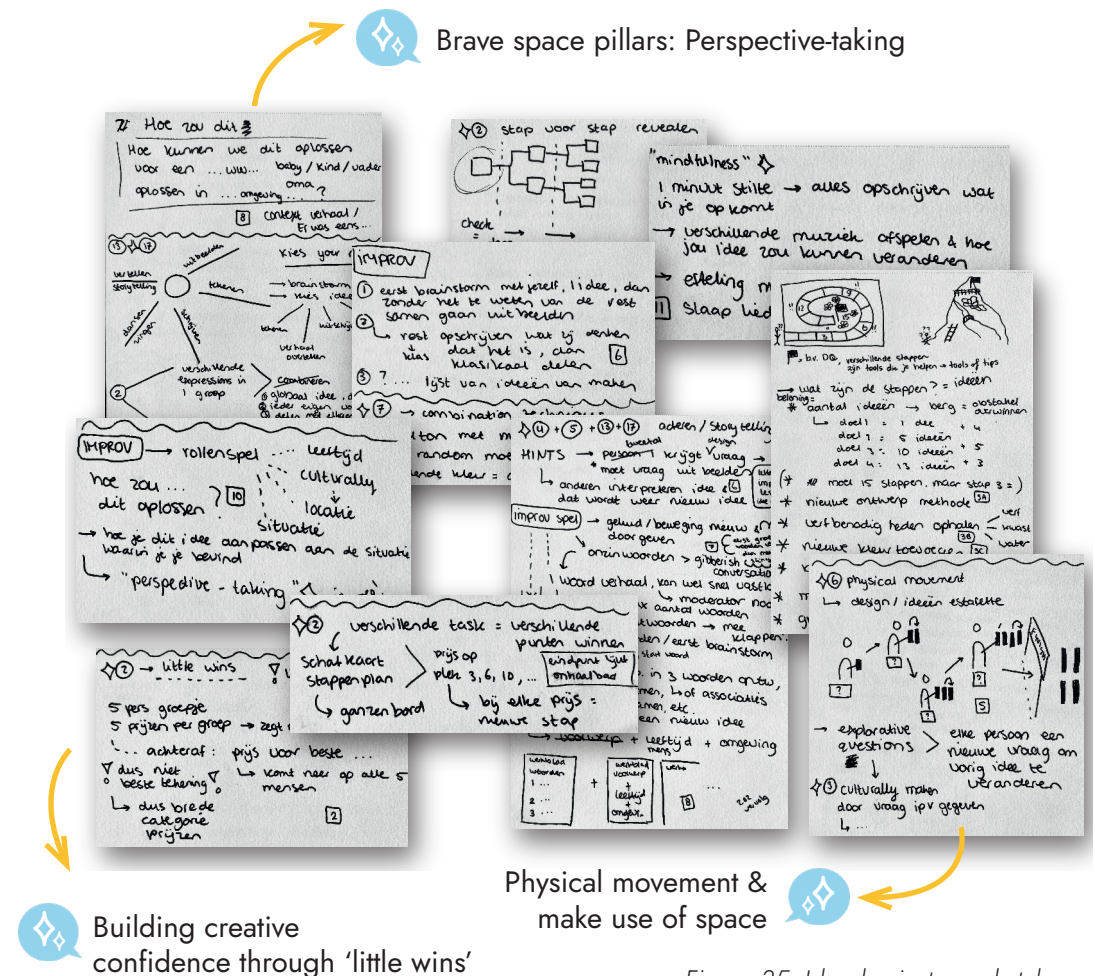


Figure 35. Idea brainstorm sketches

This iterative process ultimately resulted in six concept designs. One of these, Draai Door, has been described earlier in this thesis, while the other concepts are newly introduced. The main “inspiration spark” each concept is based on is shown in **black**, while the more general sparks it connects to are shown in **gray**.

### Concept 1: Draai Door

This concept has been the design tool used in the sessions at schools and in that process went through different iterations.

#### In short

Children build on each other’s ideas by passing them on and making them increasingly absurd (or, conversely, more realistic), thereby discovering the power of the creative process.



#### Connected sparks

- Actively switch between divergent and convergent thinking (1)
- Target humour (4)
- Association, decomposition, combination techniques (10)
- Element of surprise (14)
- Brainstorm rules (12)

### Concept 2: Ideeënboard

#### In short

This method is inspired by the traditional Ganzenbord (goose board) game but is designed to support idea generation through active reflection, encouragement, and surprising mystery cards. Each step on the board represents one idea, which is drawn on an idea-template paper as the game progresses.



#### Connected sparks

In the first place:

- Building creative confidence through ‘little wins’ (2)
- Association, decomposition, combination techniques (10)
- Element of surprise (14)

But also:

- Target humour (4)
- Brainstorm rules (12)

#### Step by step

1. Each group gets a game board.
2. The group thinks of ideas and draws them on the template – each idea is one step
3. If you land on blue, pick a reflect card.
4. If you land on red, take a mystery card and include the content in your next idea

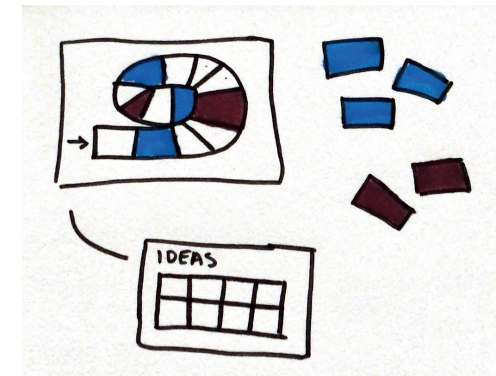


Figure 36. Sketch of ideeënboard

### Concept 3: Wat als...?

#### In short

Inspired by improvisation, this method combines idea generation with role play and empathy. Children create ideas through stories by combining random activities, with random characters, in random locations. This playful mix stimulates imagination and helps to see problems from new perspectives.



#### Connected sparks

In the first place:

- Storytelling (6)
- Brave space pillars: perspective-taking (8)
- Make materials culturally responsive (3)
- Improvisation (5)

But also:

- Target humour (4)
- Element of surprise (14)



- Other domains than just visual (13)
- Association, decomposition, combination techniques (10)

#### Step by step

1. Each group brainstorms an activity, character and a location, and hands them over to the teacher
2. The teacher randomly picks a combination of an activity, character and location.
3. The groups think of a short story of how an idea for the design problem in that specific situation
4. Each group shortly act out the situation and their idea/solution together.
5. With whole class reflect on the stories and solutions.
6. As a group write down your idea to collect the ideas
7. Do all steps again with a different combination.

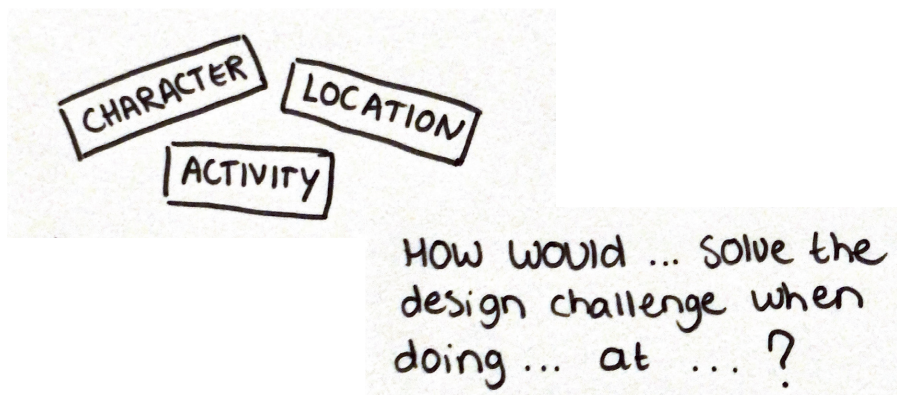


Figure 37. Sketch of Wat als...?

#### Concept 4: Ideeën estafette

##### In short

Children are divided into groups, and each group member is given a spot in the circle like a relay race (preferably outside or in PE hall). The first child comes up with an initial idea for the design question, draws it on the paper, and then runs to the next child to pass it on and explain the idea. Each child also receives an explorative question that they must use to guide their thinking for the next idea. There are no winners, just continuous running with the ideas until no new ideas remain.



#### Connected sparks

In the first place:

- Physical movement & make use of space (7)
- Association, decomposition, combination techniques (10)
- Explorative questions (11)

But also:

- Element of surprise (14)
- Make materials culturally responsive (3)
- Other domains than just visual (13)

#### Step by step

1. Split the class into small groups and each group member is given a spot in a circle.
2. Each group is given an idea-template paper and every child gets one explorative- question card.
3. Child 1 thinks of the first idea for the design question and draws it on the paper.
4. Child 1 runs to Child 2, hands over the page, and explains the idea in one short sentence.
5. Child 2 uses their question card to think of a new idea, draws it, then runs to the next child and passes it on.
6. Keep relaying until no new ideas come.

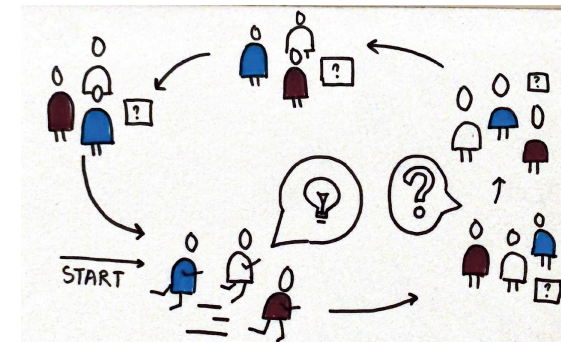


Figure 38. Sketch of ideeën estafette

### Concept 5: Mindful musical

#### In short

This activity is slower paced and inspired by mindfulness and taking time to think. It starts of in silence and slowly introduced different types of music to inspire new ideas, through talking in a group about it.



#### Connected sparks

In the first place:

- Brave space pillars: mindfulness (8)

But also:

- Target humour (4)
- Element of surprise (14)
- Other domains than just visual (13)
- Association, decomposition, combination techniques (10)

#### Step by step

1. Take 1 minute to quietly think of ideas on your own.
2. Play one piece of music for the whole class (e.g., lullaby, Efteling music, Flight of the Bumblebee, electronic).
3. Pause the music. Share what it made you think of or how it made you feel in groups.
4. Use the music as inspiration to come up with new ideas, alone or in the group. Play a new song and repeat steps 2–4.
5. Play a new song and repeat steps 2–4.

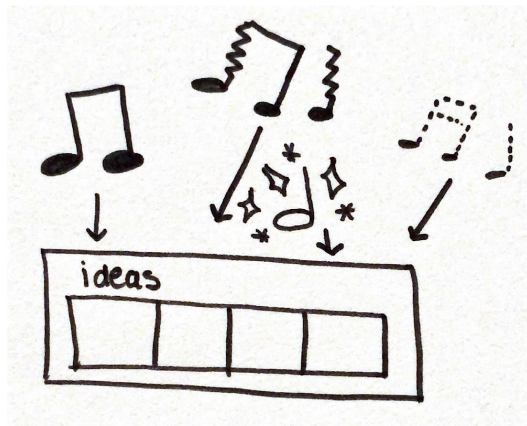


Figure 39. Sketch of mindful musical

### Concept 6: Zonnestrallen

#### In short

Many children have different talents and different ways of expressing their creativity. This method allows all children to express ideas in their own way, through drawing, acting, writing, dancing, or singing. This idea is the most conceptual one and was created for evaluation with the Science Hub, intended more as a basis for open discussion than as a finished design tool. Some possible ways the tool could look are shown below.

Option 1: ...while also collaborating with other modes of expression in a team. By combining these diverse forms, the group can build richer and more varied ideas together.

Option 2: All same modes of expressions put together in one group > less chaos (for younger ages)



#### Connected sparks

In the first place:

- Diverse way of expression (9)
- Act of creation can already be prototyping (15)

But also:

- Other domains than just visual (13)
- Storytelling (6)

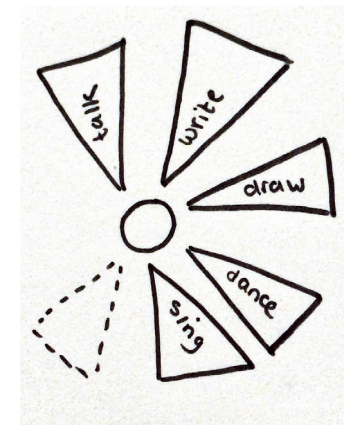


Figure 40. Sketch of zonnestrallen



## 8.1.2 Concept design tools evaluation with Science hub

The initial concepts were reviewed by project leaders from the Science Hub to assess their fit within existing materials and resources. Drawing on their expertise, they provided insights into which ideas were likely to work well, potential obstacles, and practical considerations for implementation.

The evaluation results are summarized below, highlighting key takeaways that informed the refinement and finalization of the design concepts. The evaluation helped ensure that the final designs were both feasible and aligned with the intended goal of supporting children's focus on the creative process.

### Concept 1: Draai Door

A valuable addition of the 'Draai Door' tool that was mentioned, are the step of making ideas more realistic, which does not yet exist in other methods.

One point raised about the tool was that the step of making ideas "crazier and crazier" could be difficult for children, however it was suggested that this challenge might be addressed by combining the method with 'inspiration cards' that they often use. It was also mentioned that the first idea and the final, realistic idea might sometimes turn out to be the same. On the other hand, they expected that when children go through several rounds and engage with each other's ideas, they may become less attached to their original concept, which was confirmed during the sessions at schools. Finally, it was remarked that if this tool were used in high schools, students might feel more strongly attached to their ideas. While this is outside the current project scope, it remains a relevant consideration for future adaptations.

### Take-ways for iteration:

- Orientation of paper influences the flow, consider reorganizing the squares or the orientation
- Making steps to make idea crazier, could be enhanced if the worksheet also reflected the words, for example by changing the style of the lines that shape the boxes

### Concept 2: Ideeën-bord

'Ideeën-bord' was considered a fun concept, with the gaming element seen as a strong addition. However, simply moving step by step (from 1 to 2 to 3) was thought to risk becoming too predictable, and introducing a randomizing element could make it more engaging. The random object cards were also appreciated, especially if children are required to use them rather than having the option to skip them. In the discussion, I made the suggestion to change the board into an infinity loop instead of having a fixed start and endpoint. This idea was well received, as removing the endpoint could motivate children to keep generating ideas. At the same time, this creates the need for another way of marking the end of the activity, such as through a time limit. Some uncertainty also emerged about whether the game is designed for group or individual play, and how roles like drawing cards or generating ideas should be distributed.

### Take-ways for iteration:

- Addition of randomizer for making the different steps.
- Change the shape of the board to an infinity loop.
- Think of different ways to manage the ending and how to present it to the children, for example with time.
- Instead of one format with limited number of ideas, think of way to make it infinity, e.g. post its.
- Make clearer how the game is played from a group context, who draws a card, who thinks of an idea, etc.

### Concept 3: Wat als...?

This concept was appreciated for its originality, although the title was seen as not entirely fitting, as it does not fully capture the essence of the tool. A challenge discussed was how to capture the ideas, since the current format ends with a short play of all groups performed to the whole class. A helpful suggestion was to consider the 'oplossingsverhaal' tool, a familiar tool within the Science Hub that resembles a comic strip, as it could provide a clear and familiar way for children to record their ideas. This would be especially effective if they have already used it in other activities.

Regarding the input words, post its were seen as a fun choice, though it was emphasized that teachers would need to check them beforehand.

Another issue that emerged was time management: having every group present can take too long, but randomly selecting groups may cause disappointment if some are left out.

#### Take-ways for iteration:

- Iterate the title to better capture the tool.
- Make the presentation format clearer and more usable, for example through the 'oplossingsverhaal' template.
- In the step-by-step guide, make more clear how time is managed and how to handle presentation of ideas, also make sure to add the check of the post its with input for the story.

#### Concept 4: Ideeën estafette

This concept was found harder to understand compared to others. The illustration was not very clear, and the overall activity flow was perceived as complicated. Questions arose about how the "explorative questions" would work, whether the design questions would change, and how the running element was structured. Although these aspects were described in the step-by-step, further clarification is considered necessary. A useful suggestion was to make the explorative questions specific to the waiting stations instead of keeping them with the same child, in order to add diversity and new inspiration. The physical movement element was appreciated, and it was seen as suitable for primary schools, including the possibility of conducting the activity outdoors. The evaluators also emphasized that outdoor learning provides significant benefits compared to classroom settings.

#### Take-ways for iteration:

- Most important is to better explain the flow and step-by-step, consider including a more elaborate example story of how the design tool would work in real life.
- Rethink the way new information is presented, the new ideas template, but also the rotation of explorative questions.

#### Concept 5: Mindful musical

The evaluation of Mindful musical revealed both enthusiasm and caution. A key concern was that the method may not be suitable for every child, as it can be overstimulating. Teachers would need to carefully consider the preferences of their class before using it. In schools where music is already a regular part of activities, children may benefit more from this approach, whereas in schools with little emphasis on music, it could act more as a distraction. Another point raised was that the suitability of the method may also depend on the design question. For topics that involve moods or atmospheres, such as interior design, the method could work well, but for other types of design challenges, its usefulness may be limited. Finally, it was stressed that the choice of music is very influential, and that the preparation of suitable music should not be left to teachers. Instead, providing a curated playlist or another clear selection method would be more effective.

#### Take-ways for iteration:

- Include the music to use, for example through a YouTube playlist and a QR code.
- Make teacher instructions very clear: when the tool is helpful, what to pay attention to (no visuals with the music, appropriate volume), and possibly the suggestion to carry out the activity with a music teacher if available.

#### Concept 6: Zonnestralen

The discussion of 'Zonnestralen' highlighted that the tool may be less suited for the early idea generation phase, but could become valuable in later stages such as idea development or presentation. The possibility of expressing ideas through different modes was considered stimulating, as it enables children to contribute in ways that align with their strengths while still collaborating with others. At the same time, a key challenge lies in the role of the teacher: evaluators noted that teachers often have a preferred mode of expression themselves, and for Zonnestralen to work well, they would need to step back and allow children to choose their own forms. For these reasons, the method was not recommended for use in ideation, but it will be considered a promising tool to investigate in future research for the next phases of the design cycle,

## 8.2 Idea generation for teacher support

The design direction guiding this project was formulated as follows:

**“How might we help 9–12-year-old children shift their focus from the end result to the creative process, in order to foster creative confidence, while also supporting teachers in understanding and facilitating this shift?”**

Whereas the previous idea generation concentrated on design tools for children, the attention here shifts to the second part of the question: providing support to teachers. While the proposed design tools are intended to be intuitive and effective in guiding children toward process-oriented creativity, teachers remain essential actors in enabling these conditions. Without their understanding and active facilitation, the impact of the tools risks being limited. Supporting artifacts are therefore developed to strengthen teachers’ role in fostering creativity in the classroom.

### 8.2.1 Foundations for teacher support

As explained in Chapter 5, one of the key problems in supporting creativity among children is the lack of knowledge and confidence among teachers. Although the proposed design tools themselves are intended to be accessible and to function with minimal prior expertise, the design conditions discussed earlier indicate that their effectiveness increases significantly when teachers are able to recognize and intentionally foster those conditions.

The framework of creative self-beliefs explained by Beghetto & Karwowski (2023) (introduced in Chapter 3) provides a valuable perspective. While the overall design question highlights creative confidence explicitly, other dimensions of creative self-beliefs remain highly relevant for both children and teachers.

The supporting materials are therefore designed not only to strengthen creative confidence, but also to address related beliefs that influence how creativity is valued and practiced in classrooms.

Two aspects of creative self-beliefs are particularly central:

**Creative self-image**, particularly the **perceived value of creativity**. This refers to “beliefs about the value, merit, or worth of creativity in relation to one’s broader sense of self” (Beghetto & Karwowski, 2023). When teachers gain a deeper appreciation of the value of creativity for children, they are more likely to encourage students to engage with creative processes rather than merely aiming for correct or polished outcomes.

**Creative self-awareness**, particularly through the subcategory of **creative mindset**. This concerns “beliefs about the nature of creativity itself (e.g., whether creative competence is fixed, incremental, or both)” (Beghetto & Karwowski, 2023). When teachers adopt an incremental mindset toward creativity, they model and reinforce the idea that creative skills can be developed over time, which is a perspective that helps children persist and experiment.

Taken together, these considerations suggest that a targeted effort to provide teachers with knowledge and accessible tools is a valuable addition alongside the design tools. The proposed supporting artifacts are intended to make the key design conditions visible and actionable, equipping teachers to create environments where creativity can thrive.

When taken a step further, these artifacts could also be introduced through teacher workshops, which are regularly organized by the Science Hub, or by involving teachers directly in creative exercises themselves. Engaging in such activities, either as preparation or together with the children, would allow teachers to gain personal experience with the creative process and to actively practice what they aim to foster in their classrooms.

## 8.2.2 Supporting artifacts for teachers

The proposed artifacts are a booklet complemented by a poster. The booklet functions as guide and is designed to be concise, readable in less than ten minutes, and written in clear, accessible style. This decision responds directly to insights from the context interviews presented in Chapter 4, where teachers emphasized their limited time and preference for practical, easy-to-digest resources.

The poster serves as a visual extension of the guide. Posters are already a familiar medium within classrooms, and this format enables the content to remain present as a day-to-day reminder. Rather than being hidden in a drawer or binder, the poster can function as a visible prompt that reinforces key principles of creativity throughout the teaching day.

Together, the guide and the poster create a dual support system: the guide provides a compact but comprehensive overview of the principles, while the poster ensures ongoing accessibility and integration into the classroom environment.

The content of the guide is directly informed by the design conditions, with the addition of the brainstorm rules, and it broadly covers background information on creativity and design, as well as guidance on the right environment, attitude, and what to say.

## 8.2.3 Artifact evaluation with Creative facilitation experts

To ensure the usefulness and accuracy of the artifacts, they are evaluated with two creative facilitation experts from the TU Delft. Their expertise is particularly valuable because the guide, in some extent, positions teachers as facilitators of creativity as well. By reviewing the content, the experts were asked to assess whether the framing of creativity and facilitation aligns with their established practice, and whether the explanations are sufficiently clear for teachers who may not have prior experience with creativity-focused methods.

The evaluation was guided by two central questions:

- Does the description of creativity and facilitation reflect the experts' professional experience and practice?
- Is the content understandable and practically usable for people who have little to no prior background in creative facilitation?



Figure 41. Impression of the artifacts

The expert evaluation provided several valuable insights into the clarity and usefulness of the artifacts. The page on 'what to praise' was identified as the most essential and impactful component of the guide. The experts did not report any fundamental inconsistencies with their own practices as creative facilitators. However, some comments pointed to more subtle improvements that could strengthen the guide's accessibility and tone.

One specific point of concern was the framing of the brave space pillar "leaning into fear". The phrasing was perceived as potentially negative and limiting rather than supportive. One expert even noted that the phrase brought to mind a "panic zone" rather than a "brave space." The formulation may unintentionally feel intimidating or discouraging, especially for teachers unfamiliar with creativity-oriented practices.

Another key insight is that experts emphasized the importance of teachers being mindful not to unintentionally suppress children's more unconventional ideas, especially when working with 'high achieving' children. Such children may feel like their contributions are quickly dismissed if they deviate too far from the teacher's expectations or feel redirected too rigidly toward the outcomes that the teacher had in mind. This highlights the importance of clearly explaining to teachers that they should cultivate an open mind and be non-judgmental, to ensure that children feel encouraged to explore ideas freely without fear of rejection.

#### Take-ways for iteration:

- Revise the brave space pillar "leaning into fear" so that the phrasing is encouraging rather than intimidating.
- Clarify the principle of postponing judgment to better support teachers in fostering openness during creative processes.



# final designs

- 9.1 how the designs work together
- 9.2 final supporting artifacts
- 9.3 final design tools

Chapter 9 presents the final design, namely two supporting artifacts and several design tools, and the ways in which they work together.

## 9.1 How the designs work together

The final designs are presents in figure 38, illustrating how the supporting artifacts interact with the design tools from the perspective of a teacher facilitating a design lesson.

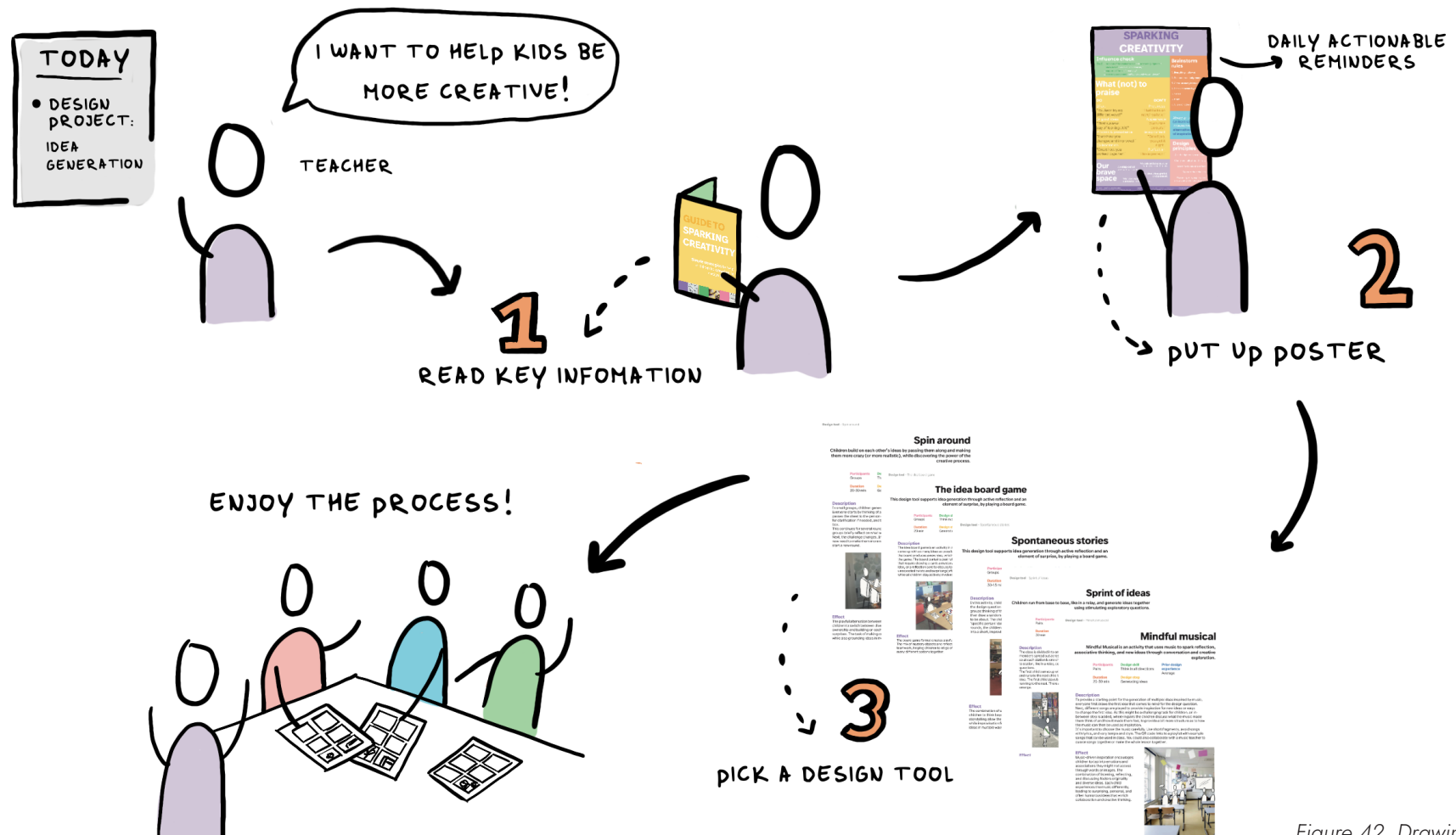


Figure 42. Drawing of how the final designs work together



## 9.2 Final supporting artifacts

The teacher booklet and poster were developed as a practical translation of the research outcomes. Their purpose is to serve as quick, accessible materials for teachers who facilitate creative activities in primary education. While the research identified several key conditions that support creativity, this artifact translates those insights into easy to understand information and actionable guidance, that can be directly applied in classroom settings.



Page 2 and 3 aim to raise awareness of the value and broader goals of creative and design activities. Based on insights from the fieldwork (see Chapter 6), many teachers held limited or mistaken assumptions about creativity, often equating it solely with artistic output.

They relate to Condition 1, which stresses the importance of making the meaning and relevance of creative activities clear to both teachers and learners. By articulating the purpose of the guide and situating its relevance, these pages aim to support teachers' understanding of why fostering creativity matters.



This introductory page defines the primary audience for this project, teachers in primary education, but also extends to others working with children in co-design or creative learning contexts.



### Rethink your role

Step out of the evaluator role and postpone your judgement. Supporting creativity means taking on many roles at once, like being a coach, a resource, and even a designer yourself.

### Your expectations matter

When you believe in a child's creativity, they start believing in their own abilities.

### Bias blocks creativity

Creativity comes in many forms and many means, so avoid favouring only high-achievers or "well-behaved" students.

### Encouragement counts

Support from a respected figure, who expresses belief in children's abilities and guides activities constructively, strongly shapes children's creative confidence.

## Know your influence

4

Derived from classroom observations and teacher interviews, this page emphasizes that teachers' attitudes and biases significantly shape how children engage in creative tasks. It connects to Condition 2 (teacher awareness of influence) and Condition 3 (recognizing and valuing all children's creativity). The related poster statements transform these insights into reflective prompts, inviting teachers to consider how their expectations, language, and examples might affect children's confidence and participation.

Adapted from the existing brave space pillars by Stubbs (2019), this page communicates the importance of psychological safety in creative learning environments. Aligned with Condition 4, it reminds teachers that creative exploration thrives when learners feel safe to express unconventional ideas, take risks, and learn from mistakes. The poster translates these principles into actionable phrases to use in the classroom.

Psychological safety gives children the courage to take risks without fear. A brave space builds on this, where six guiding pillars invite openness, curiosity, and courage.

### Vulnerability

It's okay to not know, to ask, to share

### Perspective-taking

Listen to others' stories with curiosity, not judgment

### Outside the comfortzone

Discomfort is the doorway to learning and growth

### Critical thinking

Question ideas and stay open

### Examining intentions

Pause to reflect: Am I adding something helpful and thoughtful?

### Mindfulness

Be present. Breathe. Respond with awareness

## Creating a brave space

5

## What (not) to Praise

6

### DO

Effort

"You kept trying different ways!"

Original ideas

"That's a new way of looking at it!"

Process & persistence

"I see how you changed and improved."

Collaboration

"Great how you worked together."

### DON'T

Prettiness

"That looks so neat/realistic!"

Appearance

"Such nice colours!"

Being correct

"Good job, you got it right."

Perfection

"This is perfect!"

Focusing on the role of feedback, this page highlights how emphasizing (the look of) outcomes over processes can discourage experimentation. Connected to Condition 5, it encourages teachers to shift their feedback towards effort, strategy, and persistence rather than polished results.

This section originates from the "discobal phenomenon," discussing how examples can be both helpful and limiting. In line with Condition 9, it reminds teachers that examples can scaffold understanding but may also restrict imagination if followed too literally. The page encourages strategic use of examples to inspire rather than dictate outcomes.

Examples can be helpful when design is new, giving students a clearer sense of what is possible. However, they may also **unintentionally restrict originality**, especially if children see them as the "correct" solution.

A useful approach is to always provide **several (at least 4) examples**, so that variety feels natural. Even better, **offer alternative forms of inspiration**, such as images, unusual materials, or open-ended questions, that stimulate ideas without narrowing them down.

## The power of giving examples

7



1. **Everything** is allowed

2. Postpone your **judgement**

3. Create **as many ideas as possible**

4. Ideas are **owned by everyone!**

5. **1+1=3**

6. **Draw**

7. Give each other **compliments**

## Brainstorm rules

The Science Hub often highlighted the brainstorming rules as key to setting the right tone in design projects with kids.



This final page summarizes actionable techniques for facilitating creative sessions. It corresponds to Conditions 6 - 8, emphasizing open-ended design questions, explicit learning goals, and opportunities for children to make design decisions. This page offers a practical framework for guiding design-based learning processes.




**Ask the right design question**  
Open-ended, simple and connected to the world of kids

**Clarify the why**  
Share learning goals and purpose

**Pause & reflect**  
Check in on teamwork, goals, and the design question

**Support their choices**  
Give kids choice and agency, but guide them where needed

**Other tools**  
Use energizers, explorative prototyping and iterate ideas.

## Key design principles



# SPARKING CREATIVITY

### Influence check

**Do I** ... step out of the evaluator role and postpone judgment?  
... show belief in each child's creativity?  
... support all forms of creativity?  
... give encouragement that builds creative confidence?

### Brainstorm rules

1. **Everything** is allowed
2. Postpone your **judgement**
3. Create **as many ideas as possible**
4. Ideas are **owned by everyone!**
5. **1+1=3**
6. **Draw**
7. Give each other **compliments**

### What (not) to praise

DO	DON'T
Effort	Prettiness
"You kept trying different ways!"	"That looks so neat/realistic!"
Original ideas	Appearance
"That's a new way of looking at it!"	"Such nice colours!"
Process & persistence	Being correct
"I see how you changed and improved."	"Good job, you got it right."
Collaboration	Perfection
"Great how you worked together."	"This is perfect!"

Always provide **several (at least 4) examples**, or even better, **offer alternative forms of inspiration**

### Design principles

- Ask the right design question
- Clarify and talk about the why
- Take time to pause & reflect
- Support their choices
- Use energizers, explorative prototyping and iterate ideas.

### Our brave space

- We **step out of** our comfort zones.
- We **ask and share**, even when we don't know.
- We are **kind, thoughtful, and present**.
- We listen **with curiosity**, not judgment.

This poster is part of the graduation project: Enhancing Children's Creativity: Building creative confidence through idea generation in design education at primary schools.

The graduation project: Jacobse, S.S. (2025). Enhancing Children's Creativity: Building creative confidence through idea generation in design education at primary schools. (Master's thesis, TU Delft).

Enhancing Children's Creativity - Poster English  
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Figure 43. Poster for sparking creativity

## 9.3 Final design tools

Five design tools were developed to enrich the idea generation phase of the design process. They encourage children to explore, experiment, and most importantly, focus on the creative process rather than the outcome. The full tool description and worksheets can be found in Appendix B.

Each tool is uniquely based on a different set of inspiration sparks, such as movement, humour, and storytelling. However, all designs are united by their alignment with the design requirements, such as the need for them to be simple and intuitive to use, create space for reflection, aim to spark curiosity and imagination, and foster communication and collaboration.

### 9.3.1 Draai door - Spin around

**Unique Value** Supports idea generation through... playful switching between divergent and convergent thinking.

#### Activity

In small groups, children generate ideas through being inspired by their peers' ideas. Everyone starts by thinking of and drawing a first idea on the worksheet, then passes the sheet to the person on their left. That person looks at the drawing, asks for clarification if needed, and then thinks of a crazier idea, drawing it in the next box.

This continues for several rounds until everyone gets their own sheet back. The groups briefly reflect on what was drawn and explain their ideas to one another.

Next, the challenge changes. Instead of making the ideas crazier, the students now need to make them more realistic. Again, they pass the drawings around and start a new round.

#### Impact

'Spin around' is mainly inspired by training children to actively switch between divergent and convergent thinking. This takes shape by firstly by thinking of multiple different ideas which are more and more crazy

(linked to divergent thinking), while in the next part of the activity converging again by making the idea more realistic. By making an idea crazier, the aim is for children to think beyond their regular boundaries and create a place where no failure is possible, simply because there is no limit to how crazy it can be.

The 'spinning around' with the worksheets in groups helps with focussing on the creative process by literally letting go of your first idea and handing it over to the next person, where you have no influence on what will happen with your idea. But that is also the fun and surprising part that you get the sheet of your neighbour to use for thinking of a new idea, making it interesting and enjoyable.

Within the step by step explanation on how to facilitate the activity, the first step is to talk about what crazy and realistic means, to make sure all kids have the necessary knowledge needed to actively participate. While doing this activity at schools, all kids were able to draw their ideas and sometimes with a short verbal explanation, communicate their ideas through the expression of drawing. The worksheet used with 'spin around' guides the children with how to do it through arrows, words and the visual style of the squares to draw in.

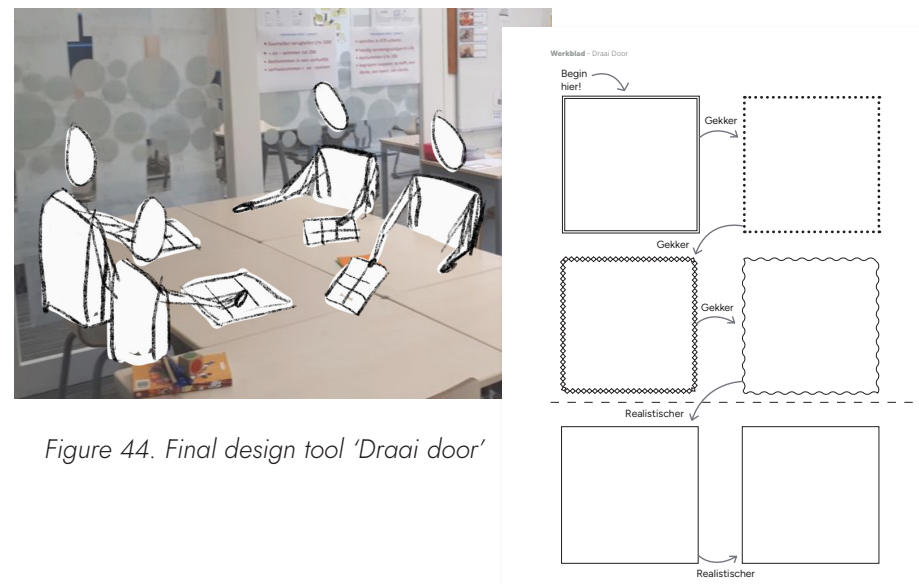


Figure 44. Final design tool 'Draai door'

### 9.3.2 Ideeënbord - Idea Board game

**Unique Value** Supports idea generation through... combining playful surprises with active reflection.

#### Activity

The idea board game is an activity in which children work in small groups to come up with as many ideas as possible for the design challenge. Each space on the board produces a new idea, which is drawn on the 'ideas template' during the game. The board contains plain white spaces, but also red and blue spaces that require drawing a card: a mystery object card to incorporate into a new idea, or a reflection card to discuss together. Thanks to the reflection moments, unexpected twists and surprising (often funny) combinations, more ideas emerge while all children stay actively involved in the creative process.

#### Impact

The dice and coloured cards introduce randomness and surprise, which spark motivation and unexpected ideas. The shape of the board is designed as a continuous loop to emphasise that the goal is to generate as many ideas as possible. This helps take away the pressure of finding 'the one perfect idea' and instead encourages children to go with the flow, even when a surprising mystery object (like a sock) needs to be included.

Although rolling the dice and moving the token are individual actions, the real thinking and reflection happen in the group. This reduces the pressure on individual children to come up with an idea, while also strengthening their teamwork skills. The reflection cards further support this process, guiding discussions and keeping everyone engaged. Meanwhile, the 'mystery objects' challenge children to stretch their creative thinking and explore unexpected directions together.

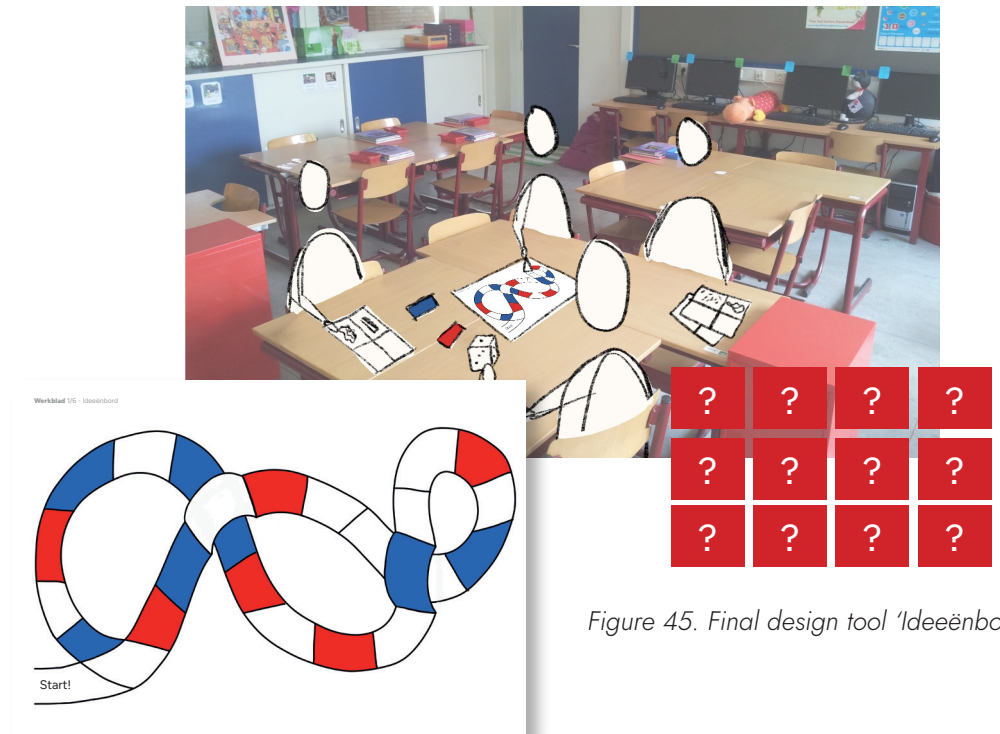


Figure 45. Final design tool 'Ideeënbord'

### 9.3.3 Spontane verhalen - Spontaneous Stories

**Unique Value** Supports idea generation through... storytelling and perspective-taking in unique contexts.

#### Activity

In this activity, children in small groups create short stories in which an idea for the design question is shared in different contexts. The activity kicks-off with all groups thinking of these activities, characters, and locations, which the teachers then draw a random combination from, to frame a context that the story needs to be about. The children then use a worksheet to explain their solution for the 'specific person' doing 'an activity' while located 'somewhere'. After a couple of rounds, the children reflect on their ideas and have the option to turn their story into a short, improvised play to show their classmates their favourite idea.



### Impact

The combinations of an activity, character, and location often lead to surprising, funny, or unusual storylines that encourage children to think outside the box. Sometimes the combination might not make sense or be very unusual, the pressure to be right or perfect is reduced, and the focus shifts toward humour and enjoyment. Working with characters helps children explore the design question from someone else's perspectives, while the improvisation element strengthens quick, flexible thinking.

Importantly, children first think of their own context elements instead of receiving a pre-made list. This gives them space to draw from their own experiences and surroundings, making the activity more culturally inclusive. Finally, the emphasis on storytelling and acting adds a layer of creative expression beyond drawing, giving space for a wider range of creative expression.

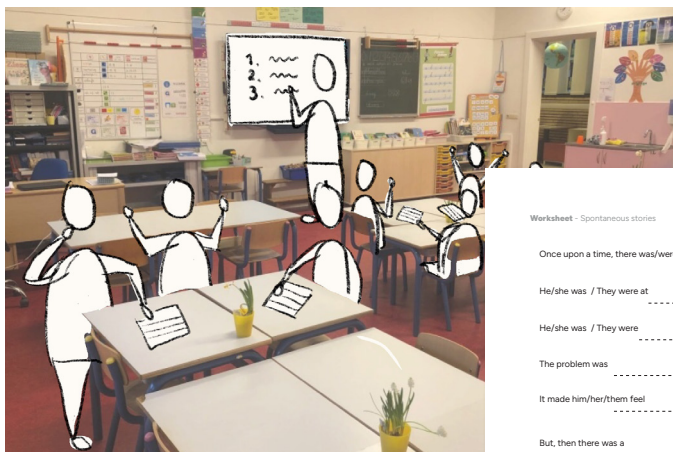


Figure 46. Final design tool 'Spontane verhalen'

#### Worksheet - Spontaneous stories

Once upon a time, there was/were ..... [ person ]

He/she was / They were at ..... [ location ]

He/she was / They were ..... [ activity ]

The problem was ..... [ design problem ]

It made him/her/them feel ..... [ effect ]

But, then there was a ..... [ design solution ]

With the ..... [ name of design ] he/she/they could ..... [ how it works ]

Now, he/she feels / they feel ..... [ effect ]

Optional drawing of the idea

## 9.3.4 Ideeën estafette - *Sprint of Ideas*

### Unique Value

Supports idea generation through... active movement and exploratory questions that spark curiosity.

### Activity

The class is divided into small groups, each with a coloured ribbon. The group members spread out across the stations, where exploratory questions are placed, so at each station is one child from each group. The children then run from station to station, like in a relay, coming up with new ideas inspired by the exploratory questions.

The first child comes up with an idea for the design challenge, draws it on a card, and runs to the next child to briefly explain it. Together, they invent and draw a new idea. The first child stays behind at that station, while the teammate continues running to the next. There are no winners; the running continues until no new ideas emerge.

### Impact

This tool combines creativity with movement, encouraging both children and teachers to be active and to go outside. There are many different sources of inspiration that help with thinking of new ideas: the exploratory questions at each station, the ideas left behind by peers, and the changing environment itself. Each new stimulus sparks fresh perspectives and curiosity.

Children their ideas draw on cards and then leave them at the station and continue running to the next. The physical act of leaving an idea behind and the urgency and fun of running to the next station, help to not overthink if an idea is good enough, as there will be new opportunities to think of other ideas throughout the whole activity. The explorative questions further provoke curiosity, invite new perspectives, and challenge children's imaginative thinking in unexpected directions.





Figure 47. Final design tool 'Ideeen estafette'

### 9.3.5 Mindful musical

**Unique Value** Supports idea generation through... music-driven inspiration and reflective thinking.

#### Activity

To provide a starting point for the generation of multiple ideas inspired by music, everyone first draws the first idea that comes to mind for the design question. Next, different songs are played to provide inspiration for new ideas or ways to change the first idea. As this might be a challenging task for children, an in-between step is added, where in pairs the children discuss what the music made them think of and how it made them feel, to provide a bit more structure as to how the music can then be used as inspiration.

It's important to choose the music carefully. Use short fragments, avoid songs with lyrics, and vary tempo and style. The QR code links to a playlist with example songs that can be used in class. You could also collaborate with a music teacher to curate songs together or make the whole lesson together.

#### Impact

The power of 'Mindful Musical' lies in combining mindfulness and music. The activity creates space for mindful reflection and idea generation, together with music in different styles and tempos. This encourages imagination and associative thinking, helping children generate original ideas they might not have thought of on their own.

The use of music as an inspiration introduces elements of surprise and humour, while also broadening creativity beyond purely visual expression. As the same piece of music can spark very different associations among children, the activity not only leads to new and diverse ideas but also stimulates meaningful conversations that strengthen communication and collaboration. The alternation of listening, reflecting, thinking and drawing makes the activity dynamic and inspiring for children.

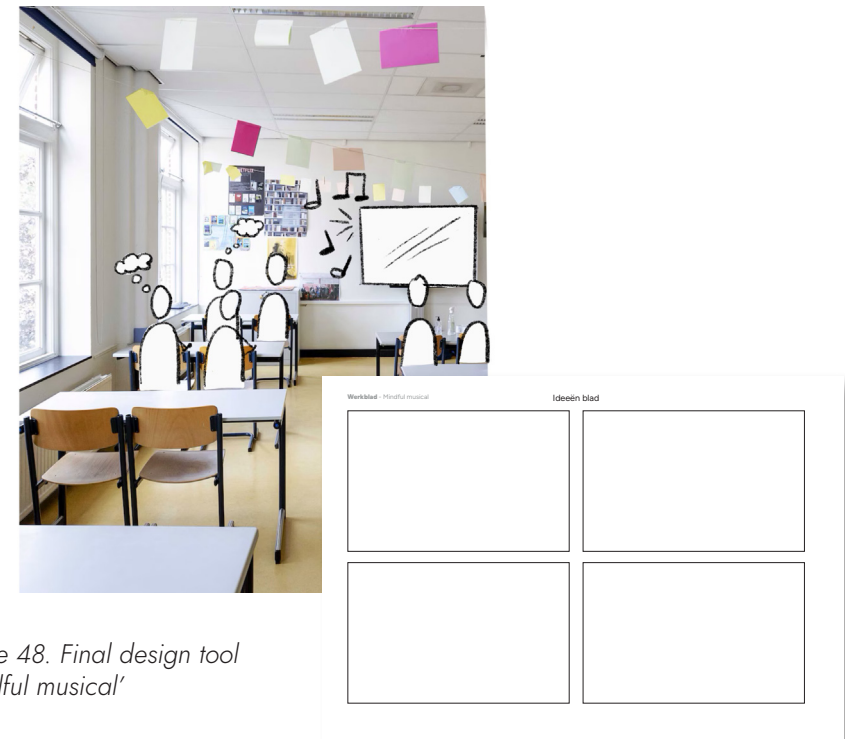


Figure 48. Final design tool 'Mindful musical'

# 10

## evaluating

- 10.1 evaluation framework
- 10.2 evaluation of the supporting artifacts
- 10.3 evaluation of the design tools
- 10.4 evaluations by others
- 10.5 design recommendations

Chapter 10 evaluates the proposed final designs with primary school teachers, reflects on findings from design students and discusses design recommendations

## 10.1 Evaluation setup

As presented in the previous chapter, the final design outcomes of this project consist of five design tools and two supporting artifacts. To assess their effectiveness and practicality, a structured evaluation was conducted with five primary school teachers (teaching groups 5–8). Two of these teachers had prior experience with O&O (Research and Design) education.

First, the teachers were asked to review the supporting artifacts and share their initial impressions. They were then asked two evaluation questions:

1. Do you understand the content?
2. Could you apply it in your classroom?

Next, the design tools and their accompanying worksheets were presented one by one. For each tool, the teachers were asked:

1. Do you think it would work in your classroom from a practical perspective?
2. Do you think it would help your students think more creatively?

These evaluation questions were deliberately chosen to keep the interviews simple and time-efficient and aimed to gather teachers' perspectives on how the tools and artifacts might work in practice, since time constraints within the project prevented classroom testing with students.

However, a few people had the opportunity to test the tools. One interviewed teacher tested the tools with her class and shared her experience using Mindful Musical. In addition, I presented the design tools to Industrial Design Engineering master's students in the course Child and Play Perspectives. Two student groups used several tools in co-design projects with children, and their insights are included as well.

Key notes and answers the questions from the evaluation interviews can be found in Appendix M.

## 10.2 Evaluation of the supporting artifacts

All participating teachers indicated that they understood the content of the artifacts. Overall, the feedback was positive, especially regarding the poster, as well as the compactness of the booklet. Teachers appreciated the concise format, noting that it felt much more accessible than the long, detailed manuals they often receive. The page on what (not) to praise was also highlighted as particularly relevant. One teacher captured its intention well, saying:

"I can hardly imagine making such comments.  
Although... maybe I do it without realizing."

This shows that the materials succeeded in encouraging reflection on teachers' own feedback and communication styles.

Some teachers mentioned that the booklet felt somewhat general and obvious. While this could mean that the content aligns with existing educational values, it might also risk being perceived as too self-evident and therefore not taken seriously enough.

The relevance of actually using the materials was also questioned by one teacher, who noted that education still mainly focuses on subjects such as mathematics and spelling, as these areas are often viewed as most important by the school inspectorate and parents. This could be enhanced, as another teacher suggested, by making clearer connections between creativity, design, and the core SLO competencies, as described in Chapter 1, to strengthen their perceived importance.

Also, one teacher emphasized the importance of focusing on process rather than outcomes from her experience, stating:

"It fits well, since education is increasingly about  
praising children for their effort and their  
learning process."

Two teachers also raised the question of what to do next after reading the booklet. While they found the content valuable, they felt the information was not yet directly applicable in their classroom. A useful suggestion was to include more practical examples, ideally linked to the design tools, showing how teachers could use the information in practice.

Finally, the concept of a brave space was considered valuable but possibly more complex in practice than the booklet suggests. One teacher mentioned that, in more challenging classes, it may first be necessary to establish a safe space before a brave space can exist, which connects to the previously mentioned psychological safety.

### Conclusion

In summary, the support artifacts were clearly understood and generally well received. Teachers appreciated their clarity, compactness, and reflective nature. At the same time, they expressed a need for deeper information on the relevance and clearer guidance on how to apply the content in practice. The findings also highlight the ongoing challenge of integrating creativity into a school culture that still prioritizes measurable academic results.

## 10.3 Evaluation of the design tools

### 10.3.1 Draai door

All teachers indicated that 'Draai door' was both feasible to implement and likely to stimulate creative thinking in their classrooms. Several teachers appreciated the clear structure and perceived it as easy to integrate into existing routines. Two teachers suggested trying it out with the whole class, before using the tool more independently, to allow children to become familiar with the format.

One teacher expressed concern that when thinking of the first 'realistic' idea on the worksheet, children might simply copy the previous idea on the worksheet. This concern had surfaced at several points during the project. However, the observations at the schools (in Chapter 6) suggested that most children did not struggle with this transition, but this was of course with a limited sample size. Further testing in a wider range of contexts could help clarify whether this is a broader issue.

Another teacher mentioned that collaboration might be difficult for younger children (group 5). However, teachers from other schools noted that pupils enjoyed working together and found it motivating. This difference might point to the possibility that the effectiveness of the collaborative element depends on school culture and children's prior experience with teamwork.

### Conclusion

Teachers viewed Draai door as a practical and potentially valuable tool to encourage creative thinking. While generally well understood and well received, further testing could explore its adaptability in schools where teamwork is less normal.

### 10.3.2 Ideeënbord

Teachers generally considered 'Ideeënbord' to be practical and manageable within their classrooms. Most expected that children would enjoy the game format, particularly the inclusion of dice, cards, and "mystery objects," which were described as original and engaging. Several teachers, however, raised concerns about the "empty" spaces on the board. These spaces were intended to allow open idea generation but were seen as potentially challenging, as there are no additional prompts or guidance.

The reflection cards were also viewed with some skepticism, as some teachers questioned whether pupils would engage with them meaningfully. One teacher raised a valid point: in the first few turns, if a child lands on a blue square, there is not much to reflect on, since they have only just begun the activity and have not yet generated many ideas. Lastly, from a practical perspective, preparation time was not perceived as a barrier.

#### Conclusion

The Ideeënbord was seen as a playful and accessible approach to fostering creative thinking. Some adjustments, such as offering more structured guidance for open tasks and refining the timing or phrasing of reflection prompts, could strengthen its usability and impact.

### 10.3.3 Spontane verhalen

All teachers recognized 'Spontane verhalen' as a tool that could support children's creative thinking. Most also found it feasible to implement in practice, as storytelling was already a familiar and well-liked activity, making the concept accessible and relevant. Though, two teachers expressed concerns about the time required for storytelling, especially when pupils needed to write down their ideas.

Two teachers noted that the suitability of the tool depends on class composition, as not every group enjoys storytelling and acting. Here it is good to note, that with all tools used in real-life design projects, teachers have the freedom to select the activities they consider doable with the children in their class.

#### Conclusion

Spontane verhalen offers a recognizable and enjoyable framework for idea generation, particularly in classes already familiar with storytelling activities. Future testing needs to proof whether the writing load is doable or if there need to be other options for capturing the stories to accommodate different class needs.

### 10.3.4 Ideeën estafette

Teachers responded positively to the 'Ideeën estafette' concept, particularly appreciating its connection to *bewegend leren* (learning through movement). They described it as an activity that could help pupils think more spontaneously, without overanalyzing their ideas. One teacher noted

"... since they're running and it's in a sort of relay form, I think it makes you rely on your first thought:  
you draw it and immediately move on.  
That's what I really like about it."

At the same time, all teachers identified the waiting time between turns as a potential challenge. Some felt this might hinder the activity's flow, while others saw it as a manageable aspect of classroom practice that could be addressed with clear instruction and supervision. Concerns were also raised regarding space requirements, classroom management, and the motivation of all pupils to participate actively.

#### Conclusion

Ideeën estafette was regarded as a lively and low-threshold way to stimulate creative thinking. Although there is much potential in this tool, further iterations are necessary, like including strategies to minimize waiting times and ways to maintain engagement.

### 10.3.5 Mindful musical

Teachers viewed the 'Mindful musical' tool as both feasible and relevant for enhancing creative thinking. It was considered easy to integrate into existing routines, and several teachers emphasized that pupils would likely enjoy the combination of music and imagination. One teacher commented that...

"I think children are even better at this than adults.."

... suggesting that music could be a particularly natural entry point for creative exploration.

Two teachers noted that the activity might be more challenging for younger pupils (group 5), suggesting that some adaptation of the activity could be beneficial to ensure accessibility across age groups. Additionally, the mindfulness questions were perceived by some teachers as potentially difficult or unfamiliar for some children. Teachers suggested including more concrete prompts or examples to support reflection.

#### Conclusion

Mindful musical was perceived as a meaningful and accessible activity that aligns with schools' growing interest in mindfulness and well-being. Adding more structured reflection guidance and adapting certain elements for younger children could enhance its inclusivity and effectiveness.

## 10.4 Evaluations by others

### 10.4.1 Design students evaluation

To complement the teacher interviews, the tools were also evaluated by two groups of Industrial Design Engineering master students (5 and 4 students respectively) from the course Child and Play Perspectives. Each group conducted a short co-design session with children, during which they could freely select and adapt the design tools. Their reflections provide insight into how the tools function in co-design with kids, where facilitation and context differ from formal classroom use.

#### Spin around

One group selected 'Spin around' and created their own simplified templates. They modified the sequence, so that the first "realistic" idea box did not end up with the same child, while the second realistic idea box did, allowing children to return to their original worksheet at the end. This variation worked effectively and supported reflection on how ideas evolve. Children were enthusiastic and proud of the number of ideas generated, saying "We made 20 ideas together!"

#### Spontaneous stories

Both student groups used 'Spontaneous stories', offering complementary perspectives.

The first group noted that while the activity provided freedom and excitement, it was sometimes difficult for children to connect the problem statement with the randomly generated scenarios. For example, the prompt "a clumsy alien in a spooky forest playing hide and seek" was considered too complex for some children to integrate with the design challenge. However, other prompts led to creative outcomes, and one child enthusiastically remarked, "We could make anything we want!" which reflected a sense of imaginative empowerment.



The second group also found 'Spontaneous stories' engaging and enjoyable. They divided children into small teams and used modified categories such as "(Famous) sibling duos," "Location," and "Type of play." While they appreciated the worksheet's structure, they observed that children's ideas sometimes emerged more naturally through conversation than through written answers. They suggested that, in some cases, open guiding questions might be more effective than rigid worksheet spaces.

### Idea board game

The 'Idea board game' was used by the second group in a co-design session on the topic of "compliments between siblings." The students described the activity as engaging and effective in generating multiple ideas, though the children sometimes became overwhelmed when repeatedly landing on "white" squares that required new idea generation. The blue squares were perceived as less stimulating, while the red ones were met with excitement but didn't appear frequently enough.

The students suggested that the distribution of coloured squares could be adjusted to create a more balanced rhythm between idea generation and reflection. They also noted that too many consecutive idea-generation turns could lead to fatigue or frustration among children.

### Conclusion

The reflections from the design students provide an additional and valuable perspective on the tools' usability, highlighting their adaptability beyond formal classroom contexts. Across both groups, the tools were perceived as stimulating, understandable, and enjoyable. The facilitating students demonstrated the ability to make on-the-spot adaptations to fit time constraints, group dynamics, and creative challenges, but also highlighted point for further iteration of the tools.

## 10.4.2 Group 5 teacher evaluation

### Mindful musical

One teacher tried out Mindful musical in her own class as part of a design project and slightly adapted the activity to fit her lesson. The teacher played six different music fragments, and during each one, the children drew or wrote down ideas inspired by what they heard. After the music stopped, they had one extra minute to finish their sketches. The brainstorming was done individually and in silence.

After all six pieces had been played, the children marked their two favorite ideas with a colored pencil and shared these ideas within their design groups. Finally, each group created a new poster combining their selected ideas and briefly presented it to the class.

According to the teacher, the activity went very well. The children were able to come up with ideas surprisingly easily, and it was interesting to see how differently they responded, some by drawing, others by writing words or short sentences. A few students got a bit distracted and acted silly during certain songs, but they quickly refocused when reminded.

### Conclusion

The teacher described the activity as successful and engaging. The children generated ideas easily and showed diverse ways of expressing them through music. The age (group 5) did not seem to be a hinderance, even though this was expected in the interviews.



Figure 49. Pictures from children using the 'Mindful musical' tool

## 10.5 Design recommendations

Although the tools were generally positively received and expected to be useful in enhancing children's creative thinking, several areas for further development emerged from the evaluations. Future iterations should involve additional testing with children across different contexts, age groups, and types of schools to ensure broader applicability. The following recommendations summarize the key points.

### Supporting artifacts (booklet and poster)

- Include practical examples or short case studies that demonstrate how the tools can be implemented effectively in real classroom settings.
- Strengthen alignment with educational frameworks, such as the SLO skills ('vaardigheden').

### Draai Door

- No direct design modifications are required at this stage; however, further research is recommended on how teamwork and peer collaboration can be effectively supported among children during the activity.

### Ideeën bord

- Reconsider the function and amount of the white spaces, ensuring they contribute meaningfully to the idea generation flow.
- Experiment with different colour compositions on the board to achieve a more balanced rhythm between idea generation and reflection.
- Make the reflection phase more engaging and valuable.

### Spontane verhalen

- Further testing in real classroom contexts is needed to determine how much time children actually require for writing their stories and reflections.
- Depending on these findings, it may be beneficial to explore alternative ways of capturing ideas, such as through audio recording, video, or drawing, to accommodate different expression styles and maintain engagement.

### Ideeën estafette

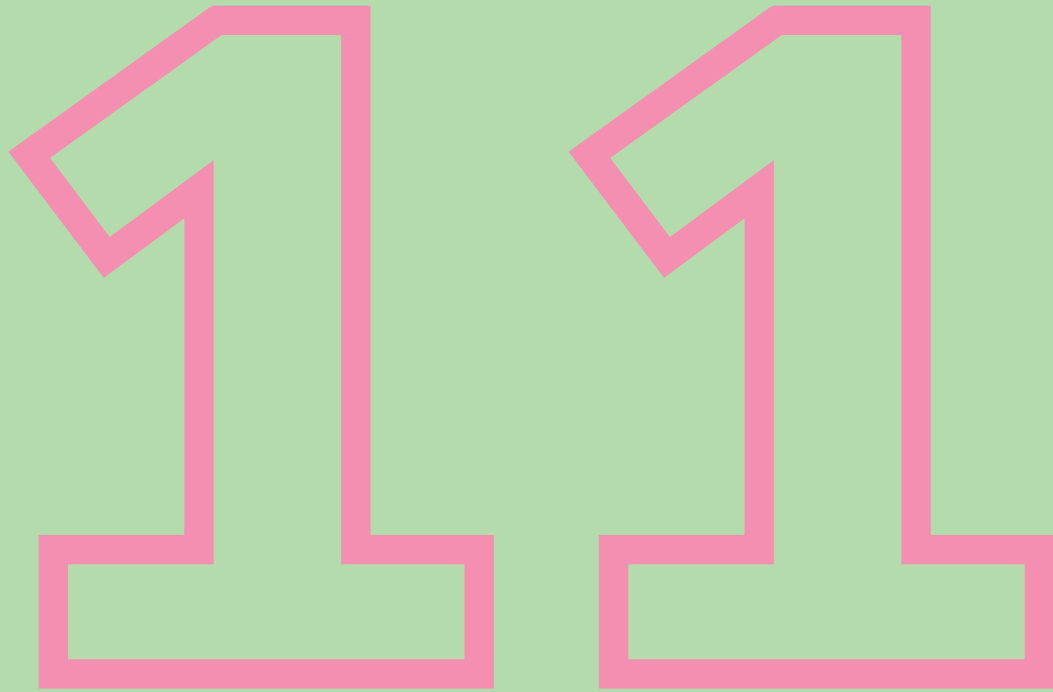
- Address waiting time between turns, which was noted as a challenge.

Possible adaptations include:

- Introducing short parallel activities that keep children engaged and contribute to the design process.
- Testing different group configurations, such as working in pairs or with the whole class simultaneously.
- Adding motivating elements to help maintain focus and enthusiasm during waiting periods.

### Mindful musical

- Develop strategies to support children unfamiliar with the mindful reflection part, helping them understand and take the activity seriously in a playful and accessible way.
- Experiment with various music types or tempos to identify which mix best supports creative thinking.



# conclusions

- 11.1 conclusion
- 11.2 limitations
- 11.3 future research
- 11.4 personal reflection

Chapter 11 discusses the conclusions, limitations and suggests areas for future research

# 11.1 Conclusion

This project set out to support and enhance children's creative confidence and creative thinking, particularly during the idea generation phase of the design process. Building on the Your Turn materials developed by the Science Hub TU Delft, it addressed the need for creativity-supportive resources in education that align with the growing importance of 21st century skills.

Throughout the research phase (involving literature research, context exploration and Research through Design activities), key barriers were identified: result-driven school cultures that constrain open exploration, limited teacher guidance on fostering creativity, and the sensitivity of children's creative confidence when not continuously supported. Informed by these challenges, design tools and teacher resources were designed to help focus on the process rather than final outcomes.

Overall, the design tools and supporting materials were well received by primary school teachers and demonstrated a clear potential to foster creative thinking and creative confidence in classroom contexts. Teachers valued the clarity, accessibility, and reflective qualities, though they expressed a need for deeper contextual guidance and more explicit connections to the curriculum. The individual tools were regarded as engaging, adaptable, and effective in stimulating creativity. There were suggestions to improve usability, structure, and inclusivity. Feedback from both teachers and design students underscored the tools' flexibility across different settings and age groups, while also highlighting the continued challenge of embedding creativity within a school culture focused on measurable academic outcomes.

Overall, this project contributes several designs that make creative thinking more tangible and actionable in primary education. It underscores the importance of fostering creativity as a process of exploration, reflection, and confidence-building. Building on these insights, the next sections consider the key limitations and outline directions for future research.

The research phase was guided by the research question:

**"How is creativity supported during the idea generation phase among primary school children aged 9 to 12?"**

The development phase was guided by the design question:

**"How might we help 9–12-year-old children shift their focus from the end result to the creative process, in order to foster creative confidence, while also supporting teachers in understanding and facilitating this shift?"**

## 11.2 Limitations

While this thesis has demonstrated the potential of a process-oriented approach to enhance children's creative confidence, the outcomes were achieved within specific contexts and conditions. The following points outline the main limitations related to theoretical framing, researcher involvement, sampling, and the scope of testing.

### Theoretical framework

Creativity is a broad and multifaceted concept that can be interpreted through many lenses. In this study, the 5 A's of Creativity framework was used to define and analyse creativity. The framework provided clarity and coherence. However, using a different framework could have led to alternative insights or design directions.

Similarly, the project focused on creative confidence within the broader concept of creative self-beliefs, but it excluded other relevant self-belief constructs, limiting the breadth of the analysis.

### Researcher involvement

As the facilitator of the workshops and the observer during the design lessons, my presence may have influenced how children engaged with the activities. Despite efforts to maintain a natural and supportive classroom atmosphere, the awareness of being observed and guided by a researcher could have affected their behaviour, enthusiasm, or focus.

### Sample and context

The number of participating teachers, children, and schools was limited. Although the sample was intentionally varied in terms of school culture and experience with idea generation, the findings remain context-specific and exploratory rather than representative. Differences between schools, such as teaching styles, classroom dynamics, and curricular priorities, influenced the results and their transferability.

### Scope of testing

Among the developed tools, only Draai Door was tested directly in classroom settings with children. The remaining tools were assessed through teacher feedback, rather than hands-on classroom implementation. As such, the usability, timing, and practical flow of these tools in everyday classroom conditions requires further validation.

These limitations highlight valuable opportunities for continued development and research, which are discussed in the following section.

## 11.3 Future research

The following directions for future research highlight opportunities to expand understanding of creativity, collaboration, and the learning environment.

### Exploring broader self-belief constructs

While this study focused on creative confidence, all creative self-beliefs interact with each other and possibly also with more general self-beliefs. Future research could investigate these interconnections and their influence on children's creative engagement, providing a more holistic understanding of creative development.

### Teamwork and collaborative dynamics

Teamwork was observed to be a valuable but also complex aspect of children's creative work. Children's experiences with collaboration, as well as teachers' facilitation strategies, varied considerably. Further research could examine how group dynamics, peer interactions, and collaborative strategies shape creative confidence, and how these factors can be supported across different classroom environments.

### Psychological safety and brave spaces

Psychological safety and brave spaces are important in fostering creativity. These are very context-dependent. Future studies could explore how emotional maturity, social norms, and classroom culture influence children's willingness to take creative risks, particularly in design projects that encourage unconventional or innovative thinking. Understanding how to cultivate safe yet challenging environments could inform more effective classroom practices.

### Supporting creative confidence in later design stages

This study focused on early stages of the design process. Future research could investigate how creative confidence can be nurtured during later phases, such as idea selection, prototyping, and iteration. These stages involve increased judgment and evaluation, which may shift focus from process-oriented to outcome-oriented, which could create additional challenges for maintaining creative confidence.

### Cross-contextual validation

Finally, given the context-specific nature of this study, replicating and extending these findings across diverse educational settings, age groups, and cultural contexts would strengthen understanding of how process-oriented approaches to creativity can be adapted and scaled effectively.



## 11.4 Personal reflection

When I started this project, I knew I wanted to explore creativity, but I didn't realize how complex it really is and how many aspects influence it. In the past months, I learned that creativity isn't something you can easily define and it unfolds (and becomes more complex) as you explore it.

Working with children was one of my favourite parts. They were honest, funny, curious, and sometimes completely unpredictable, which made every session a surprise. Watching how freely they generated ideas reminded me how naturally creative kids are when they feel safe and excited. It also showed me how much potential there is for teachers to support that process, not just by encouraging creativity, but by creating the right conditions for it to happen.

I also learned a lot about organizing and facilitating creative sessions, both with experts and in classrooms. Things never went exactly as planned (especially with 10-year-olds in the mix), but that's what made it exciting.

Early on, the project's direction was still developing, which sometimes made it difficult to see the big picture. But over time, I learned to **trust the process**, which funnily is exactly what the project focus came to be. Letting go of control and staying open to what emerged was one of my biggest personal takeaways.

Nearing the end of the project, one of the best parts was seeing how teachers responded to the final tools and materials, and how excited they were to use them in their lessons. It made me realize how much potential there is in this topic and how far it could still go.

I'm proud of what came out of it, but even more of what I learned along the way, about creativity, about working with people, and about myself.

– Sarah

12

**references**

- Abbott, D. H. (2010). *Constructing a creative self-efficacy inventory: A mixed methods inquiry* (Order No. 3402936). ProQuest Dissertations Publishing. <https://www-proquest-com.tudelft.idm.oclc.org/dissertations-theses/constructing-creative-self-efficacy-inventory/docview/305217740/se-2>
- Amabile, T. M. (1983). *The social psychology of creativity*. Springer-Verlag.
- Amabile, T. M. (1996). *Creativity in context: Update to the social psychology of creativity*. Westview Press.
- Arao, B., & Clemens, K. (2023). From safe spaces to brave spaces. In *Routledge eBooks* (pp. 135–150). <https://doi.org/10.4324/9781003447580-11>
- Atwood-Blaine, D., Rule, A. C., & Walker, J. (2019). Creative self-efficacy of children aged 9–14 in a science center using a situated mobile game. *Thinking Skills and Creativity*, 33, 100580. <https://doi.org/10.1016/j.tsc.2019.100580>
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman.
- Beghetto, R. A., & Karwowski, M. (2023). Creative self-beliefs: From creative potential to creative action. In *Elsevier eBooks* (pp. 179–193). <https://doi.org/10.1016/b978-0-323-91840-4.00010-4>
- Beghetto, R. A., Kaufman, J. C., & Baxter, J. (2011). Answering the unexpected questions: Exploring the relationship between students' creative self-efficacy and teacher ratings of creativity. *Psychology of Aesthetics, Creativity, and the Arts*, 5(4), 342–349. <https://doi.org/10.1037/a0022834>
- Beghetto, R. A. (2013). Nurturing creativity in the micro-moments of the classroom. In K. H. Kim, J. C. Kaufman, J. Baer, & B. Sriraman (Eds.), *Creatively gifted students are not like other gifted students* (Advances in Creativity and Giftedness, Vol. 5, pp. 3–16). SensePublishers. [https://doi.org/10.1007/978-94-6209-149-8\\_2](https://doi.org/10.1007/978-94-6209-149-8_2)
- Buchanan, R. (1992). Wicked problems in design thinking. *Design Issues*, 8(2), 5–21. <https://doi.org/10.2307/1511637>
- Calavia, M. B., Blanco, T., Casas, R., & Dieste, B. (2023). Making design thinking for education sustainable: Training preservice teachers to address practice challenges. *Thinking Skills and Creativity*, 47, 101199. <https://doi.org/10.1016/j.tsc.2022.101199>
- Cropley, A. J. (1999). Creativity and cognition: Producing effective novelty. *Roeper Review*, 21(4), 253–260. <https://doi.org/10.1080/02783199909553972>
- Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly*, 44(2), 350–383. <https://doi.org/10.2307/2666999>
- Gericke, K., Eckert, C. M., & Stacey, M. (2017). What do we need to say about a design method? In *International Conference on Engineering Design, ICED17* (p. 21). University of Luxembourg, The Open University, & De Montfort University. <https://www.researchgate.net/publication/319315521>
- Gielen, M., & Vegt, N. (2024). *Co-creation with youth* [Online course]. TU Delft. [https://onlinecourses.tudelft.nl/courses/course-v1:TUDelft+CCWY1+2024\\_Q1/about](https://onlinecourses.tudelft.nl/courses/course-v1:TUDelft+CCWY1+2024_Q1/about)
- Ginns, P., Martin, A. J., Freebody, K., Anderson, M., & O'Connor, P. (2023). Creative self-beliefs among children and adolescents. *Australian Journal of Education*, 67(2), 181–195. <https://doi.org/10.1177/00049441231153508>
- Glăveanu, V. P. (2013). Rewriting the language of creativity: The five A's framework. *Review of General Psychology*, 17(1), 69–81. <https://doi.org/10.1037/a0029528>
- Gonçalves, M. (2016). *Decoding designers' inspiration process* [Doctoral dissertation, Delft University of Technology]. <https://resolver.tudelft.nl/uuid:a270cdf2-d46b-4085-8f4f-328b823ccdee>
- Guilford, J. P. (1950). Creativity. *American Psychologist*, 5(9), 444–454. <https://doi.org/10.1037/h0063487>
- Hadani, H. (2015). *Inspiring a generation to create: Critical components of creativity in children*. Center for Childhood Creativity at the Bay Area Discovery Center.
- Hooijdonk, M. V., Mainhard, M. T., Kroesbergen, E. H., Tartwijk, J. W. F. V., & The Authors. (2023). Creative problem solving in primary school students. *Learning and Instruction*, 88, 101823. <https://doi.org/10.1016/j.learninstruc.2023.101823>
- Howard-Jones, P. A. (2002). A dual-state model of creative cognition for supporting strategies that foster creativity in the classroom. *International Journal of Technology and Design Education*, 12(3), 215–226. <https://doi.org/10.1023/a:1020243429353>
- Karwowski, M. (2022). School does not kill creativity. *European Psychologist*, 27(3), 263–275. <https://doi.org/10.1027/1016-9040/a000449>
- Karwowski, M., Lebeda, I., & Beghetto, R. A. (2019). Creative self-beliefs. In J. C. Kaufman & R. J. Sternberg (Eds.), *The Cambridge handbook of creativity* (pp. 396–418). Cambridge University Press.
- Kelley, D., & Kelley, T. (2013). Creative confidence: Unleashing the creative potential within us all. *Stanford Social Innovation Review*. <https://doi.org/10.48558/XSA6-0F24>
- Klapwijk, R. (2017). Creativity in design. In C. Benson & S. Lawson (Eds.), *Teaching design and technology creatively* (pp. 51–72). Routledge.

- Klapwijk, R. M., & Stables, K. (2023). Design learning: Pedagogic strategies that enable learners to develop their design capability. In D. Gill, M. Irving, M. McLain, & D. Wooff (Eds.), *Bloomsbury handbook of technology education* (pp. 271–289). Bloomsbury.
- Klapwijk, R., & Van Den Burg, N. (2019). Formative assessment in primary design education: Involving pupils in clarifying the learning goal of divergent thinking. *Design and Technology Education: An International Journal*, 24(3), 10–27.
- Klapwijk, R., Gielen, M., Schut, A., & Van Mechelen, M. (2021). *Your turn for the teacher – Guidebook*. TU Delft. <https://www.tudelft.nl/yourturn>
- Kokkinaki, K., & Georgiadou, Z. (2024). Children as the designers of their everyday life: Integrating design thinking in primary education. *European Journal of Education Studies*, 11(5). <https://doi.org/10.46827/ejes.v11i5.5278>
- Kudrowitz, B., & Wallace, D. (2010). Improvisational comedy and product design ideation: Making non-obvious connections between seemingly unrelated things. In *Proceedings of the 7th International Conference on Design and Emotion*.
- Lewis, T. (2006). Creativity: A framework for the design/problem-solving discourse in technology education. *Journal of Technology Education*, 17(1), 36–53. <https://doi.org/10.21061/jte.v17i1.a.3>
- McGehee, W. D. (2022). Constructing creative confidence with LEGO® Serious Play®. *Journal of Behavioral and Applied Management*, 22(2). <https://doi.org/10.21818/001c.38522>
- Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why isn't creativity more important to educational psychologists? Potentials, pitfalls, and future directions in creativity research. *Educational Psychologist*, 39(2), 83–96. [https://doi.org/10.1207/s15326985ep3902\\_1](https://doi.org/10.1207/s15326985ep3902_1)
- Rhodes, M. (1961). An analysis of creativity. *Phi Delta Kappan*, 42(7), 305–311.
- Robinson, K. (2006, February). Do schools kill creativity? [Video]. *TED Talks*. [https://www.ted.com/talks/sir\\_ken\\_robinson\\_do\\_schools\\_kill\\_creativity](https://www.ted.com/talks/sir_ken_robinson_do_schools_kill_creativity)
- Robinson, K. (2011). *Out of our minds: Learning to be creative* (Rev. and updated ed.). Capstone Publishing. <https://doi.org/10.1002/9780857086549>
- Roël-Looijenga, A. (2021). *Enhancing engagement for all pupils in design and technology education: Structured autonomy activates creativity* [Doctoral dissertation, TU Delft]. <https://doi.org/10.4233/uuid:8248a6de-1e98-4fcc-9acd-4bffd54232a4>
- Roozenburg, N. F. M., & Eekels, J. (1995). *Product design: Fundamentals and methods*. Wiley.
- Said-Metwaly, S., Fernández-Castilla, B., Kyndt, E., Van Den Noortgate, W., & Barbot, B. (2020). Does the fourth-grade slump in creativity actually exist? A meta-analysis of the development of divergent thinking in school-age children and adolescents. *Educational Psychology Review*, 33(1), 275–298. <https://doi.org/10.1007/s10648-020-09547-9>
- Schut, A., Klapwijk, R., Gielen, M., & de Vries, M. (2019a). Children's responses to divergent and convergent design feedback. *Design and Technology Education: An International Journal*, 24(2), 67–89. <https://openjournals.ljmu.ac.uk/DesignTechnologyEducation/article/view/1311>
- Schut, A., Klapwijk, R., Gielen, M., van Doorn, F., & de Vries, M. (2019b). Uncovering early indicators of fixation during the concept development stage of children's design processes. *International Journal of Technology and Design Education*, 30(5), 951–972. <https://doi.org/10.1007/s10798-019-09528-2>
- Silva Ordaz, M., Klapwijk, R., & van Dijk, G. (2018). Supporting learning design language in primary education. In *Research and practice in technology education: Perspectives on human capacity and development* (pp. 278–287). 36th International Pupils' Attitudes Towards Technology Conference.
- SLO, & Sol, Y. (2024). *Vergelijking nieuwe categorisering van vaardigheden met 21e-eeuwse vaardigheden*. [https://www.slo.nl/publish/pages/21963/vergelijking-nieuwe-categorisering-van-vaardigheden-met\\_21e-eeuwse-vaardigheden.pdf](https://www.slo.nl/publish/pages/21963/vergelijking-nieuwe-categorisering-van-vaardigheden-met_21e-eeuwse-vaardigheden.pdf)
- SLO. (2019). *Leerlijnen voor 21e-eeuwse vaardigheden: Kijkwijzers voor het volgen van ontwikkeling*.
- SLO. (2025). *Vaardigheden in het landelijke curriculum*. <https://www.slo.nl/thema/meer/vaardigheden-landelijke-curriculum>
- Sol, Y., & Visser, A. (2023). *Vaardigheden in het landelijke curriculum: Verantwoording van de categorisering en definiëring van vaardigheden bij de actualisatie van kerndoelen en examenprogramma's*. Amersfoort: SLO.
- Stappers, P. J., & Giaccardi, E. (2014). Research through design. In M. Soegaard & R. F. Dam (Eds.), *The encyclopedia of human-computer interaction* (2nd ed.). Interaction Design Foundation. <https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/research-through-design>
- Stubbs, V. D. (2019). *The 6 pillars of a brave space*. <https://www.ssw.umaryland.edu/media/ssw/field-education/2-The-6-Pillars-of-Brave-Space.pdf>
- Sun, M., Wang, M., & Wegerif, R. (2020). Effects of divergent thinking training on students' scientific creativity: The impact of individual creative potential and domain knowledge. *Thinking Skills and Creativity*, 37, 100682. <https://doi.org/10.1016/j.tsc.2020.100682>

Thijs, A., Fisser, P., & van der Hoeven, M. (2014). *21e eeuwse vaardigheden in het curriculum van het funderend onderwijs*. SLO.

Torrance, E. P. (1968). A longitudinal examination of the fourth grade slump in creativity. *Gifted Child Quarterly*, 12(4), 195–199. <https://doi.org/10.1177/001698626801200401>

Valqueresma, A., Coimbra, J. L., & Costa, P. (2022). Creative self-efficacy scale for children and adolescents (CASES): A development and validation study. *International Journal of Psychological Research*, 15(1), 55–69. <https://doi.org/10.21500/20112084.5410>

Van Boeijen, A., Daalhuizen, J., & Zijlstra, J. (2020). *Delft design guide: Perspectives – models – approaches – methods*. TU Delft. <https://research.tudelft.nl/en/publications/delft-design-guide-perspectives-models-approaches-methods>

Van Broekhoven, K., Belfi, B., & Borghans, L. (2022). Instructing children to construct ideas into products alters children's creative idea selection in a randomized field experiment. *PLoS ONE*, 17(8), e0271621. <https://doi.org/10.1371/journal.pone.0271621>

Van Mechelen, M., Gielen, M., Vanden Abeele, V., Laenen, A., & Zaman, B. (2014). Exploring challenging group dynamics in participatory design with children. *IDC '14* (pp. 269–272). <https://doi.org/10.1145/2593968.2610469>

Van Mechelen, M., Zaman, B., Laenen, A., & Vanden Abeele, V. (2015). Challenging group dynamics in participatory design with children: Lessons from social interdependence theory. *IDC '15*. <https://doi.org/10.1145/2771839.2771862>

Wetenschapsknooppunt TU Delft & ontwerpbureau Meeple. (2015). *Bouwstenen ontwerpend leren*. [https://ontwerpenindeklas.nl/wp-content/uploads/2015/09/verdieping\\_ontwerpvragen.pdf](https://ontwerpenindeklas.nl/wp-content/uploads/2015/09/verdieping_ontwerpvragen.pdf)

Wetenschapsknooppunt TU Delft & ontwerpbureau Meeple. (2018). *Kraak je hersens. Ontwerpen in de klas*. [https://ontwerpenindeklas.nl/wp-content/uploads/2018/06/samenindeklas\\_kraakjehersens.pdf](https://ontwerpenindeklas.nl/wp-content/uploads/2018/06/samenindeklas_kraakjehersens.pdf)

Wetenschapsknooppunt TU Delft. (n.d.-a). *Onderzoek & ontwikkeling*. TU Delft. Retrieved September 1, 2025, from <https://www.tudelft.nl/wetenschapsknooppunt/onderzoek-ontwikkeling>

Wetenschapsknooppunt TU Delft. (n.d.-b). *TU Delft*. <https://www.tudelft.nl/wetenschapsknooppunt>

13

**appendix**



# appendix

Appendix A – Graduation brief	2
Appendix B – Final design tools	6
Appendix C – The seven critical components of creativity	28
Appendix D – Interview guide (teachers)	29
Appendix E – Mapped findings visual	30
Appendix F – From findings to problems	31
Appendix G – Design game workshop	32
Appendix H – Creative confidence questionnaire	33
Appendix I – Observation list	36
Appendix J – Design lesson materials	37
Appendix K – Inspiration sparks	55
Appendix L – Harris profiles	56
Appendix M – Evaluation interviews	57