

## Codebook—Judges’ comments on pupils’ design ideation

### Coding guidelines

- Each sentence serves as the smallest unit of analysis and can receive multiple codes. One piece of comment can receive repeating codes if the code is seen in more than one sentence in that comment
- The (+/-) sign means the category contains coding of that criterion being expressed in either positive or negative ways
- The codes should be assigned based on what the judges actually mentioned in the comments, and NOT what you interpreted about pupils’ designs/solutions themselves based on the information given in the comments

Code system	Definition	Examples
<b>Novelty</b>		
<b>Creative/out-of-the-box (general) (+/-)</b>	Judges commenting on a design being ‘creative’ or ‘out-of-the-box’ in a general way that does not fall into the above-mentioned categories, that is, without mentioning that it is new and rare, exhibiting uncommon mechanisms, combining different ideas, taking a different direction, or modifying a usual idea	<p>“the concepts are less creative”</p> <p>“Ideas on the left consider unrelated objects which is outside the box”</p>
<b>Original/unique (+/-)</b>	Judges commenting on a design being innovative, new, original, unique, rare, fresh, not often seen, or proposing a new concept; also on a design being an obvious idea, similar to other frequently seen or existing solutions	<p>“Ideas on the left are a bit boring because it is obvious”</p> <p>“one on the right mainly has one idea but that one is very unique and creative to me”</p>
<b>Different starting point (+)</b>	Judges commenting on a design taking a different direction or perspective, changing the context, or reframing the scope of the problem; could be expressed in these forms: "instead of (a common way) the child did (new and different) way" "it's not about a (common idea)...but about..."	<p>“the child did not think about the fries or the packaging but rather what the seagulls really want which in the end is just food”</p> <p>“The one on the right instead of being a container for fries is a container for fans to keep the gulls away which is creative in looking at the problem”</p>
<b>Creatively combining different ideas (+)</b>	Judges commenting on a design being a creative and meaningful combination of different concepts that may have otherwise been common ideas	<p>“Left has not so creative ideas but combines it to a somewhat creative end result”</p> <p>“the shining sticker is more creative and it is combined with a logo”</p>
<b>Uncommon mechanism (mechanical/structural) (+)</b>	Judges commenting on an uncommon mechanism—a specific structure or mechanical component—in the design, including the shape, the structure, the compartments and components, the way of assembling/attaching parts of the design, or the motion or interaction generated due to these compartments, that are unusual, novel, or not seen before	<p>“The idea of linking all these elements and make them activate in sequence is really unique”</p> <p>“the right one is a bit more creative with the mechanism of the box and the use of drones to deliver the fries”</p>
<b>Idea qualities</b>		
<b>Good (general) (+)</b>	Judges commenting on an idea/design as good in general, incredible, awesome, amazing, nice, or cool	<p>“Hard to pick one or the other because they followed a good design process”</p> <p>“right develops them further into newish novel ideas! Awesome!”</p>

<b>Smart (+)</b>	Judges commenting on an idea/design as smart, clever, genius, brilliant	<p>“the approach of connecting the predator with a piece of art (genius!)”</p> <p>“left side is a very elegant and smart solution to the problem”</p>
<b>Imagination (+)</b>	Judges commenting on an idea/design that reflects imagination	<p>“I like how the playfulness in the ideas and use of imagination.”</p> <p>“making their brainstorm more creative in terms of senses imagined”</p>
<b>Interesting (+)</b>	Judges commenting on an idea/design as interesting	<p>“left has more interesting ideas like taming the seagulls”</p> <p>“left has ideas like scarecrow which is interesting way of using learning from one to another”</p>
<b>Fun &amp; playful (+)</b>	Judges commenting on an idea/design as fun, funny, or playful	<p>“I like how the idea thinks of not only protecting the fries but also makes it fun by making a play park for children”</p> <p>“Funny they have written names on the fries.”</p>
<b>Idea potential (+)</b>	Judges commenting on how the ideas can have creative potentials for further development	<p>““The right one have a lot of ideas about the fries box &amp; mechanism which in the future they can scope down or develop them”</p> <p>“left has simple solution which makes it interesting and promising both”</p>
<b>Under-developed Ideas (-)</b>	Poor ideation quality, straightforward or surface-level shallow thinking, lack of effort, or when judges specifically mention there’s only one idea with not much elaboration, simple in a bad way, zero explanation given, showing little-to-no development in ideas; this code is only negative	<p>“Left is hard to understand because there is no annotation but it seems to be just one idea.”</p> <p>“ideas on the right are really basic.”</p>
<b>Aesthetics &amp; desirability (+/-)</b>	Judges commenting on the design being aesthetically pleasing, or that certain features of the design can make it appealing and desirable for people	<p>“the ideas have a nice look making them also appealing the eye”</p> <p>“The left one looks more fancy so i vote for that”</p>
<b>Sustainability (+/-)</b>	Judges’ appreciation or concern for the whether the resources are reusable or not, or whether the solution appears to be sustainable, eco- friendly, recyclable or not	<p>“the left considers problems like environmental protection” “it’s also reduce food waste at the same time”</p>
<b>Usability</b>		
<b>Multiple elements/features (+/-)</b>	Judges describing a design as containing multiple elements, compartments, multiple steps or procedures, multiple different features; (-) when there is a lack of multiple elements	<p>“LEFT sticks to the packaging itself and explores ideas around that and involves different elements”</p> <p>“the right ideas are more creative as the child did not only think about packaging but did consider the use of sound smell as well as color”</p>

<b>Multiple functions/purposes (+/-)</b>	Judges describing a design as performing multiple functions or serving different purposes; (-) when there is a lack of multiple functions	<p>“The idea has multiple functions or solves more than one problem”</p> <p>“the different functions that the product integrates are all interconnected”</p>
<b>Useful &amp; functional (+/-)</b>	Judges commenting on whether a design/solution is functional, effective, useful, or whether the proposed solution can actually work to solve the problem or not; also commenting on the design being practical or convenient for the design problem or not	<p>“mask and invisible fries mirror all the ideas "hide" and fries very well.”</p> <p>“right doesn't provide many details about the product how it would work and leaves me wondering if it is really effective.”</p>
<b>Simple &amp; intuitive (+/-)</b>	Judges commenting on a design product or solution as easy or intuitive to use; also refers to simplicity (elegance) of a solution as a desired trait; (-) also coded when judges mention a design product or solution being unnecessarily complex or even chaotic	<p>“sometimes using simplicity and good storytelling can make the difference even if the idea is not so mindblowing”</p> <p>“The design on the left looks a bit confusing and overcomplicated.”</p>
<b>Tailored for the context (+)</b>	Judges mentioning that there are specific considerations demonstrated in the design product or solution that are tailored for the context, e.g., the design showed considerations for how it fit into the beach environment, or specifically the sandy/windy beach; or the design smartly leverage things that already exist on the beach, e.g., beach umbrella, beach bench	<p>“the decision is based on how well they are integrated with the context of use”</p> <p>“I like the playfulness in the ideas and how fry smell blower and a fries shooter fits interestingly in the beach environment”</p>
<b>User experience &gt; judges' considerations (+/-)</b>	Judges expressing appreciation or concerns for the kinds of user experience indicated by pupils' design; could be possible adverse side effects that pupils have not thought of themselves (e.g., “people might not like being in the nets”)	<p>“the concept is a bit shallow because it doesn't explore how the device would affect the experience of eating fries”</p> <p>“most of the design ideas are easy to use and can be used by everyone”</p>
<b>User experience &gt; pupils' considerations (+)</b>	Judges noticing that the design reflected pupils' consideration of user experience, including making something easier to use for the users, adding specified features for specific groups, or pupils considering how both human and the seagulls could be the users of the design and how they would experience or interact with the design	<p>“Ideas on the right keep different types of target groups in mind.”</p> <p>“I love that the child did also think about people with disabilities and included that perspective in their ideas.”</p>
<b>Feasibility</b>		
<b>Considering materials (+/-)</b>	Judges commenting on pupils' consideration of the materials they need for making or producing their design	<p>“but right additionally considers materiality and communicates how it won't hurt seagulls”</p> <p>“LEFT offers more variety and explores more the idea with different materials (raft net tent etc.)”</p>

<b>Involving technology (+/-)</b>	Judges commenting on technology used or technical element involved in the design seen, could be positive or negative	<p>“although they include some interesting technology such as sensors to detect seagulls they don't stand out.”</p> <p>“Left: Use technology to feed the seagull (drone) also provide alternative idea like ultrasonic sound.”</p>
<b>Cost-effectiveness (+/-)</b>	Judges expressing appreciation or concern for the cost and resources induced by making or implement the proposed design, or judges noticing pupils' cost-effectiveness considerations	<p>“ the right one used touch-ID which is higher cost and unnecessary here.”</p> <p>“the left one use extra bread to distract seagulls which costs more resources.”</p>
<b>Realistic to make (+/-)</b>	Judges commenting on whether it is possible/feasible to realize or realistic to make the design; (-) could involve concern for seemingly unrealistic and impossible setups	<p>“the one on the right is more creative but less plausible”</p> <p>“right is more appropriate for the given challenge since the size of the project is way smaller and easier to realize.”</p>
<b>Presentation</b>		
<b>Elaborated details (+/-)</b>	Judges mentioning that the presentation of the design is rich with elaborations and details or not	<p>“each concept has more detailed explanations”</p> <p>“A bit difficult to assess the left one since not many explanations were given.”</p>
<b>Clarity in explanation (+/-)</b>	Judges commenting on the design presented being clearly or unclearly explained, in terms of clarity in both textual and figural explanations; also coded when judges find the ideas understandable or confusing	<p>“None of the ideas is explained or illustrated clearly”</p> <p>“some drawings are a bit vague.”</p>
<b>Quality of drawing (+/-)</b>	Judges commenting on elaborative, aesthetically good, well-made drawing or poor drawing, or drawing showing the design from different viewpoints or angles (pure drawing quality, not to be mixed with clarity in drawing)	<p>“the drawing is a bit too simple”</p> <p>“Left showed more visualization skills”</p>
<b>Storytelling (+)</b>	Judges commenting on the design/sets of ideas showing good storytelling abilities, or presented with story plots	<p>“right seems to have a small story which showcases the idea”</p> <p>“sometimes using simplicity and good storytelling can make the difference”</p>
<b>Problem-solving</b>		

<b>Thought-through solutions (+/-)</b>	Judges explicit commenting on the design solution as thought- through, in-depth, worked-out, thorough, showing a range of considerations, a lot of thoughts, logical, coherent, cohesive, or not; it could involve noticing that the child addressed the multiple steps needed to implement the design, different possible scenarios that may be generated, or presenting the solutions from multiple different angles, or that the child took into consideration various possible issues arising from the design; only mentioning “elaborated” or “detailed” do not suffice this code and should go to “presentation > elaborated details”	<p>“Right explores 2 more out of the box ideas in more depth.”</p> <p>“the candidate thinks it trough towards a details newish packing design”</p>
<b>Meeting the design brief (+/-)</b>	Judges consideration of whether the design solution is appropriate for the design brief (not harming the seagulls, appropriate for human users, appropriate for the beach environment); also when judges mention whether the design solution is problem-oriented, achieving the key design goal or not	<p>“The design on the right is more appropriate for the given challenge”</p> <p>“Right has pulled it a bit too far with a chillroom with airconditioning, too far away from the assignment.”</p>
<b>Idea generation</b>		
<b>Diverse directions (+/-)</b>	Judges commenting on the brainstormed ideas being diverse, varied, or a broad, wide range of ideas that are of different kinds and in multiple directions, showing divergent thinking, and showing that the kid has explored the solution space widely; or judges mentioning that the ideas are focused, narrowed, all in similar direction, and did not explore the solution space much; for example, if mentioned—many different ideas—this would be coded only as diverse directions and not quantities of ideas	<p>“Ideas on the left are all in similar direction.”</p> <p>“right offer a much wider and crazier exploration with no connection to each other”</p>
<b>Variations of a key idea (+/-)</b>	Judges commenting on the brainstormed ideas being varied versions of a key idea or key concept, without going into different directions; also use this code when iteration on a key idea is seen in the brainstorm	<p>“Ideas on the left are iterated nicely”</p> <p>“Right sticks to the same container but with different 'toppings”</p>
<b>Quantities of ideas (+/-)</b>	Judges commenting on the quantities of ideas, such as, more, multiple, several, a lot of, multiple, a good amount of ideas, or, e.g., mentioning that there are fewer ideas or only two or three ideas; this code is given when the judge mentions only quantity of the ideas without mentioning whether the ideas are diverse or varied	<p>“I only vote for left because it has an higher quantity of ideas”</p> <p>“right shows more ideas, quantity will lead to quality during a brainstorm”</p>

## Codebook—Judges’ comments on pupils’ design prototypes

### Coding guidelines

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<b>Original/unique (+/-)</b>	Judges commenting on a design being innovative, new, original, unique, rare, fresh, not often seen, or proposing a new concept; also on a design being an obvious idea, similar to other frequently seen or existing solutions	<p>“It stands out as an original idea compared to the more straightforward container solution.”</p> <p>“I did see this also in other ideas already though”</p>
<b>Different starting point (+)</b>	Judges commenting on a design taking a different direction or perspective, changing the context, or reframing the scope of the problem; could be expressed in these forms: "instead of (a common way) the child did (new and different) way" "it's not about a (common idea)...but about..."	<p>“The child focuses on the delivery of the fries and not the packaging.”</p> <p>“it creates opportunities for exercising and meeting other people so changes the context a lot!”</p>
<b>Modify an otherwise usual idea (+)</b>	Judges commenting on the core design idea being common, but noting that the creative features added to the design made it distinct from the otherwise conventional types of usage	<p>“they also though of the bottle spraying based on a timer, which would make it a bit more innovative then already existing scent sprays”</p> <p>“I also like that the rethought how the fries can be stored in a bag rather than a box. Which is why I think it is the more creative option.”</p>
<b>Creatively combining different ideas (+)</b>	Judges commenting on a design being a creative and meaningful combination of different concepts that may have otherwise been common ideas	<p>“I like that the left one uses play predators in combination with the sound of playing kids”</p> <p>“I think the left design is a bit more out-of-the-box thinking with the use of water and sound to repel the seagulls.”</p>
<b>Uncommon mechanism (mechanical/structural) (+)</b>	Judges commenting on an uncommon mechanism—a specific structure or mechanical component—in the design, including the shape, the structure, the compartments and components, the way of assembling/attaching parts of the design, or the motion or interaction generated due to these compartments, that are unusual, novel, or not seen before	<p>“left design is more innovative using rubber mouth-like openings so it can keep original state automatically.”</p> <p>“materials used are creative (mirroring string foldable technique)”</p>

Idea qualities		
<b>Good (general) (+)</b>	Judges commenting on an idea/design as good in general, incredible, awesome, amazing, nice, or cool	“left one is a amazing idea for the packaging” “right seems like a cool idea”
<b>Smart (+)</b>	Judges commenting on an idea/design as smart, clever, genius, brilliant	“scaring the seagulls by using the mirror is quite smart”
<b>Surprising (+)</b>	Judges commenting on an idea/design as surprising, shocking, unexpected	“The left design surprised me and put a smile on my face.”
<b>Interesting (+)</b>	Judges commenting on an idea/design as interesting	“the context aware solution is interesting and creative”
<b>Fun &amp; playful (+)</b>	Judges commenting on an idea/design as fun, funny, or playful	“There is a mechanism that takes multiple steps to protect the fries in a funny way.” “The kid thought about how to scare away seagulls in a playful way.”
<b>Considerate (+)</b>	Judges commenting on an idea/design as thoughtful or considerate	“This one is more thoughtful and think about most detail.” “The description for left one is very considerate and like a designer.”
<b>Idea potential (+)</b>	Judges reasoning about how the idea/design makes them think further about certain aspects, designs having creative potential, or judges’ reasoning that the design could have certain potential if improved	“the bubble idea might ruin the fun at the beach but it shows more opportunities to iterate” “another umbrella but creative starting point for further ideas”
<b>Under-developed Ideas (-)</b>	Judges commenting on the design being poor, boring, a lack of in-depth thoughts, straightforward thinking, simple in a bad way, zero explanation given, showing little-to-no development in ideas; this code is only negative	“Though less is more left is too simple.” “The right one does not really have a design its a tent in the form of a cube.”
<b>Aesthetics &amp; desirability (+/-)</b>	Judges commenting on the design being aesthetically pleasing, or that certain features of the design can make it appealing and desirable for people	“from an aesthetic perspective the right one looks better” “I like that they made it attractive for children with the seagull head.”
<b>Sustainability (+/-)</b>	Judges’ appreciation or concern for the whether the resources are reusable or not, or whether the solution appears to be sustainable, eco- friendly, recyclable or not	“New simple material (rubber plastic) seems reusable” “They also thought of things like energy conservation”
<b>Explorative (+/-)</b>	Judges commenting on whether the child has explored different possibilities, or considered expanding the solution space	“The right design is more explorative of different solution spaces.” “But more ideas on how to safeguard the fries seem to have been explored”

Usability		
<b>Multiple elements/features (+/-)</b>	Judges describing a design as containing multiple elements, compartments, multiple steps or procedures, multiple different features; (-) when there is a lack of multiple elements	<p>“There are multiple elements involved in the design”</p> <p>“The right has many features but they are all rather common.”</p>
<b>Multiple functions/purposes (+/-)</b>	Judges describing a design as performing multiple functions or serving different purposes; (-) when there is a lack of multiple functions	<p>“the left one is the more creative design as the idea can be reused for many purposes”</p> <p>“It also uses learning from one kind of usage (scarecrow in farming) to another (eating fries) - which makes it interesting.”</p>
<b>Useful &amp; functional (+/-)</b>	Judges commenting on whether a design/solution is functional, effective, useful, or whether the proposed solution can actually work to solve the problem or not; also commenting on the design being practical or convenient for the design problem or not	<p>“from the aspect of usage left is better the holes in right one might not easy letting the fries to go out.”</p> <p>“the food gun design with the speaker is good but might be less convenient to use.”</p>
<b>Simple &amp; intuitive (+/-)</b>	Judges commenting on a design product or solution as easy or intuitive to use; also refers to simplicity (elegance) of a solution as a desired trait; (-) also coded when judges mention a design product or solution being unnecessarily complex or even chaotic	<p>“It is a pretty simple solution however still very effective.”</p> <p>“Hard to understand and overcomplicated and focused on technological aspects.”</p>
<b>Tailored for the context (+)</b>	Judges mentioning that there are specific considerations demonstrated in the design product or solution that are tailored for the context, e.g., the design showed considerations for how it fit into the beach environment, or specifically the sandy/windy beach; or the design smartly leverage things that already exist on the beach, e.g., beach umbrella, beach bench	<p>“the right is better fitting to the scene.”</p> <p>“I like the way of thinking about the folding working with what is already there.”</p>
<b>Customization (+)</b>	Judges mentioning that the design offers customizable, personalized features or options, e.g., offering different sizes, different versions for different target groups or different scenarios	<p>“right- considerate in providing different sizes”</p> <p>“left - that it is customizable and shows the both the front and side of the product making it more clear.”</p>
<b>User experience &gt; judges' considerations (+/-)</b>	Judges expressing appreciation or concerns for the kinds of user experience indicated by pupils' design; could be possible adverse side effects that pupils have not thought of themselves (e.g., “people might not like being in the nets”)	<p>“the left one is using small cabinet house to protect but it might conflict with the idea that people want to enjoy the environment.”</p> <p>“the fact that it's foldable makes it a even more enjoyable solution.”</p>



<b>User experience &gt; pupils' considerations (+)</b>	Judges noticing that the design reflected pupils' consideration of user experience, including making something easier to use for the users, adding specified features for specific groups, or pupils considering how both human and the seagulls could be the users of the design and how they would experience or interact with the design	<p>"Left idea is more creative since it thinks about the target group's comfort."</p> <p>"Left is more creative as it also covers something positive for the birds."</p>
<b>Feasibility</b>		
<b>Considering materials (+/-)</b>	Judges commenting on pupils' consideration of the materials they need for making or producing their design	<p>"Left also thinks about materials that should be used"</p> <p>"Some details are also given (size of the seagull predator the movement and materials chosen)"</p>
<b>Involving technology (+/-)</b>	Judges commenting on technology used or technical element involved in the design seen, could be positive or negative	<p>"It is nice that this person thought about the solar panel"</p> <p>"Details given are creative (".. specific volume chosen" "..run on batteries.." "..via bluetooth..")."</p>
<b>Cost-effectiveness (+/-)</b>	Judges expressing appreciation or concern for the cost and resources induced by making or implement the proposed design, or judges noticing pupils' cost-effectiveness considerations	<p>"Everyone will buy their own and buy refills of fries' shows thinking of how the design is financially feasible"</p> <p>"The glass barrier seems a bit hard to afford and implement in every beach"</p>
<b>Realistic to make (+/-)</b>	Judges commenting on whether it is possible/feasible to realize or realistic to make the design; (-) could involve concern for seemingly unrealistic and impossible setups	<p>"The left design is more "Wizard-of-Oz" style there's quite some magic needed to make it work"</p> <p>"The one on the right instead is less creative but is a plausible solution"</p>
<b>Presentation</b>		
<b>Elaborated details (+/-)</b>	Judges mentioning that the presentation of the design is rich with elaborations and details or not	<p>"the portable fry box is well designed with options for 3 sauce dipping and detailed on how it work"</p> <p>"The solution on the right is way less elaborate and is based on a not very realistic technology"</p>
<b>Clarity in explanation (+/-)</b>	Judges commenting on the design presented being clearly or unclearly explained, in terms of clarity in <u>both textual and figural</u> explanations; also coded when judges find the ideas understandable or confusing	<p>"Simple yet also very complicated solution which isn't thought through explanation lacks."</p> <p>"The design process in clear and notes are easy to understand"</p>

<b>Quality of drawing (+/-)</b>	Judges commenting on elaborative, aesthetically good, well-made drawing or poor drawing, or drawing showing the design from different viewpoints or angles (pure drawing quality, not to be mixed with clarity in drawing)	<p>“Nice drawings from multiple angle.”</p> <p>“At least the drawing is quiet nice with the checkered design.”</p>
<b>Problem-solving</b>		
<b>Thought-through solutions (+/-)</b>	Judges explicit commenting on the design solution as thought- through, in-depth, worked-out, thorough, showing a range of considerations, a lot of thoughts, logical, coherent, cohesive, or not; it could involve noticing that the child addressed the multiple steps needed to implement the design, different possible scenarios that may be generated, or presenting the solutions from multiple different angles, or that the child took into consideration various possible issues arising from the design; only mentioning “elaborated” or “detailed” do not suffice this code and should go to “presentation > elaborated details”	<p>“Right idea is more creative because the kid worked out a full story / scenario.”</p> <p>“the design does not seem thought in depth”</p>
<b>Meeting the design brief (+/-)</b>	Judges consideration of whether the design solution is appropriate for the design brief (not harming the seagulls, appropriate for human users, appropriate for the beach environment); also when judges mention whether the design solution is problem-oriented, achieving the key design goal or not	<p>“The right one seagull attractant uses chemical solutions to keep seagulls away from people but this might be against the design principle of not harming the seagull.”</p> <p>“Creating a new safe space (= building in this sense) seems less creative than designing a very problem oriented box for the fries.”</p>