Promoting Creativity in the Secondary Design and Technology Classroom in England

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Purpose of the research

- The study's aim is to **explore biomimicry** as one of the design approaches in a Design and Technology classroom.
- Through **developing of an appropriate teaching strategy for including biomimicry in the design process** as a means for encouraging students to "use a variety of approaches to generate creative ideas and avoid stereotypical responses when responding to design briefs" (DfE, 2013, p. 2).

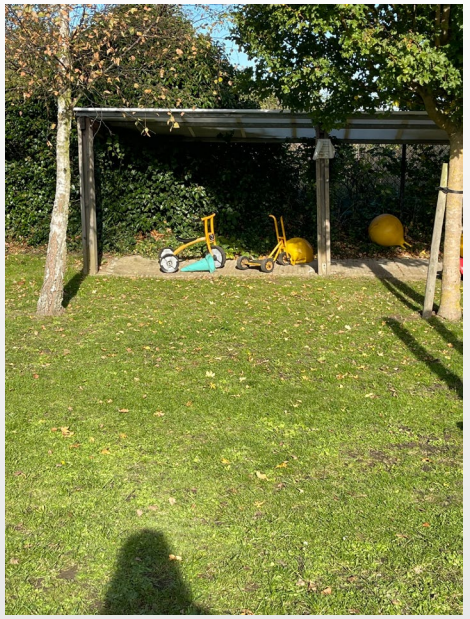
Methodology

- Action research.
- Based in a design and technology classroom.
- The research participants were a design and technology class of year 9 pupils (aged 13 – 14).
- 14 pupils participated in the research.
- Data was collected through
  - Open ended questionnaire for pupils.
  - Questions asked by pupils.
  - Drawings produced by pupils.
  - Artifacts produced by pupils

Background

- Pupils were given a **design brief** that was sent by a real client, which was a **primary school neighbouring the school (research site)**.
- The design brief emphasised a real-life problem for the client. The **client stated** that they required **'a range of nature inspired products that would encourage wildlife habitation in their school compound**'.
- The **design limitations** were to **create a range of products that would be safe for the children in the school compound** and **welcome wildlife such as birds, squirrels, hedgehogs into an identified space in the school**.

Images of the intended location off the final product



Methodology

- Data was collected over a period of **a block of 10 weeks**.
- In each week, pupils had a design and technology lesson of approximately 140 minutes.
- The lessons were divided into **pre-intervention**, **intervention**, and **post-intervention** phases.
- The pre-intervention phase required preparing a set of teaching resources to introduce pupils to the concept of biomimicry.

Table 1.
The structure of lessons compared against Barlex and Steeg (2017)

Lesson	Length (Minutes)	Instructional strategies used in this study	Barlex and Steeg (2017) approach
1 – Pre-intervention	45	Introducing the client Discussing the design brief	Stakeholder Conceptual
	45	Visit to a natural habitat that neighbours the school	Conceptual
2 – Pre-intervention	First 45	Pupils were shown images of the client's compound	Stakeholder Conceptual
	45	Generating ideas Modelling ideas	Aesthetic Technical Constructional
3, 4 and 5 Intervention	140 each	Generating ideas Modelling ideas using cardboard. Intervention introduced	Aesthetic Technical Constructional
6, 7 and 8 Post-intervention	140 each	Making the final product	Aesthetic Technical Constructional Stakeholder

Data analysis

- This section represents the three stages of the 'think, design and make' process that defined the project methodology.
- Pupils' curiosity about the environment and different functions of nature were projected through the questions they asked.
- It was observed that pupils were able to express thoughts, ideas, and curiosity about the natural world after intervention through the questionnaire tool that was used by teachers.
- The questionnaire tool presented questions such as name two or more wildlife that you observed, describe the details of any animal home structures, sizes, behaviours you may have observed, questions you would like to be addressed and note anything you are curious to know more about.

Results

- This section presents data from four pupils: Alfie, Maria, Thomas, Zafar (pupils names are pseudonyms). The data presented shows pupils' questions, drawings, models, and final products to provide a view of their shift in thinking through their individual design journeys.

- Table 2. Transition in Thomas's question before and after intervention

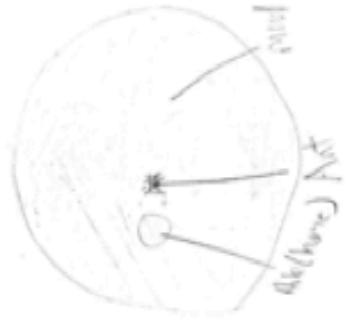
Initial design thinking process before intervention	Curiosity projected through nature of questioning after intervention
Why do hedgehogs come out only at night?	There must be more holes and enclosed spaces, so the animals feel safe

- Thomas's inquisition moves from general knowledge on the behaviour of the wildlife to a more specific question to support his designedly thinking.

Results

- This process of thinking and the use of nature based intervention materials helps him to ideate a living space for a chosen wildlife, make quick models and develop a prototype, which are shown on Table 3.

Table 3.
Three stages of Alfie's drawing, modelling and making

Initial drawing	Final development of the cardboard model	Final prototype
		

Discussion:

- The questioning tool allowed pupils to ask questions based on what they observed. For instance, pupils asked questions that showed curiosity about the environment around them. For example, Thomas asks, "why do hedgehogs come out only at night?" or Alfie's curiosity to know "how long does it take for bees to find the queen and a home". Engaging in such a thinking process and producing a range of questions indicates pupils' willingness to examine the contextual challenge (meeting clients' design needs) to inform their decision-making process.
- Their developed questions identified elements of wanting to solve real problems that resonated with their local situation

Discussions:

- Examples of pupils' questions in the tables also highlight expressions of developing ecological awareness.
- For example, Thomas commented that "there must be more holes and enclosed spaces for animals to feel safe", which suggests that the pupil is beginning to understand the challenges animals could be facing in a wild space, while also trying to find design solutions to these challenges.
- The contextualization of the challenge made the task become more personal to them. "How are we going to find the right space to place the homes we make for the animal?" suggests Maria's thinking beyond what she had observed. It could be inferred that the pupil is trying to inquire about possibilities for design ideas in designing and building a bird nest.

DRAWING, MODELLING AND FINAL PRODUCT PHASE.

- Pupils' design models display significant patterns, and mimics features found in nature. Pupils' initial drawing, final development of the cardboard model and the final prototype. In developing the models, pupils showed the process of introducing alternative solutions following evaluation of existing solutions.

- As seen in table 3, Alfie decided to construct a product that would attract bees. Specifically, using an insects body structure as a starting point for the construction of the main structure of his design. The concept of housing items within the body of the insect (like a hive with holes) stimulated the idea of the holes on the product for the bees to live in.

Examples of pupils' drawings, models and final product

- Maria took the idea of how an apple fruit keeps its seeds intact and safe inside (see table 5). She used the concept to construct a home for wildlife and in considering the aesthetic element they maintained the natural shape of an apple.

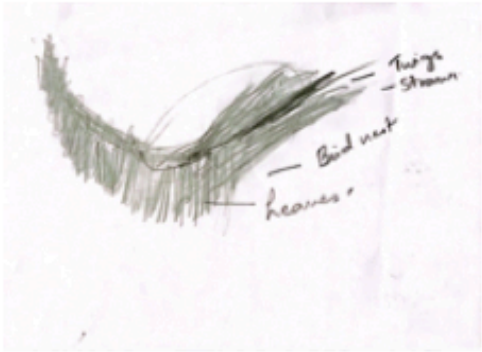
Table 5
The three stages of Maria's drawing, modelling and making

Initial drawing	Final development of the cardboard model	Final prototype
		

Examples of pupils' drawings, models and final product

- Not only did Zafar base his design in the form of a leaf but also considered the function of a leaf in a plant, as a surface for processing food. He argued that a good leaf must look tough and protect the beings inside of it..

Table 7 Three stages of Zafar's drawing, modelling and making

Initial drawing	Final development of the cardboard model	Final prototype
		

Conclusion

- In developing solutions, the pupils had to make decisions about the **appearance** and **construction**, while considering different stakeholder preferences.
- Such decisions include how the item works and the technical decisions.
- In the case of an item to attract wildlife, for example birds, it works by being relatively **inconspicuous** – an aesthetic decision.
- Having the correct size hole to attract certain animals was an important part of **observation that was then incorporated in the achieved construction design**. If the pupils were trying to attract butterflies, then the decisions would require different observations and would involve different specifications in constructing a suitable home for wildlife.
- The interventions provided to pupils in their design and task enhanced **their responses to the identified design need**.
- The biomimicry approach was embraced by pupils who developed a range of original and creative nature inspired products, and our findings confirm that **pupils valued opportunities that involve questioning solutions presented by nature**.
- Each of the twelve pupils produced a **prototype that had an inspiration from nature**, not only in their **form** but also the **decisions behind how the products would fun**ction.

Images of products in the intended location

Further research

- Further research could be designed to understand pupils' understanding of biomimicry as a design approach.
- This would be helpful if integrated with an understanding of how biomimicry improves pupils' learning outcome in their Design and Technology classroom.

References

- Barlex, D., & Steeg, T. (2017). *Re-building Design & Technology*. Retrieved June 26, 2022, from David and Torben for D&T: https://dandtfordandt.wordpress.com/resources/re-building-dt/