Supporting Learning Design Language in Primary Education

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Learning in Design and Technology (D&T) education has often a collaborative nature. Recently, it has been acknowledged that although collaboration and communication skills are learned through D&T education, it is necessary to support the development of these language skills. One of these skills is the ability to present design ideas to stakeholders outside the classroom. In our case study, pupils aged 9-12 years provided input for professional sport designers and presented their intermediate ideas to them half-way a six-week co-design project. Even when pupils are skilled communicators, it may be difficult for them to present design ideas. The language of design and creativity has specific features that most pupils are unaware of and have not yet experienced in an active way. To talk about a design that does not yet exist in the physical world, but is only a possibility, requires specific skills. As a result, the involved professional designers will quite often have difficulties in grasping the pupils design ideas and their feedback to forward the design idea may not achieve its full potential. Therefore, in our case study, genre-pedagogy was used as a reference to support building the design language field. The teacher taught pupils how to present ideas by using learning strategies, like modeling design presentations with a video, joint construction using worksheets and pupil-led construction of presentations on their own design. The results indicate that pupils discovered the importance of naming an design idea, using a problem-solution narrative structure and paying attention to the user, but they did not apply all these features in their own presentations In the last session with the problem owner, the pupils were able to elaborate their design idea during the presentation with body language, adding drama, gestures and role-play.

Key Words: Communication Skills, Co-design, Human Centred Design, Design Based Learning.

1. INTRODUCTION

In Human Centered Design the role of the user has been amplified. Many different approaches exist to involve users in an early stage in the design project and take their wishes and experiences into account. Although observing and interviewing are useful, more recently users are asked to do user research among their peers (Klapwijk & Van Doorn, 2015) and to develop design ideas in cooperation with the professional designers jointly throughout various cycles (Maguire, 2001).

Co-design projects are also undertaken with children (Druin & Inkpen, 2001; Klapwijk & Van Doorn, 2015; Schut, van Doorn, Klapwijk, & Buchner, 2017; Van Mechelen, Gielen, vanden Abeele, Laenen, & Zaman, 2014), often in a school-context. As such children provide input for social change by sharing their experiences and design ideas with professional designers; however, attention for learning goals and skill development of the children during these projects has been limited up till now.

The project "Co-design with Kids" of the Delft University of Technology and partners is meant to make a change in this respect by simultaneously striving for educational goals and relevant input for professional designers.

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Real life design challenges offer pupils the opportunity to use language in a functional way (Halliday & Hasan, 1989). However, in our first series of case-studies we observed that professional designers in co-design projects quite often do not get sufficient information from intermediate design presentations to understand the children's design ideas. The lack of proficiency in design language hampers co-design projects in various ways. First, the professional designer does not get high quality user-input. Second, the dialogue with the professional designers and their feedback to forward the design idea did not achieve its full potential.

Communication in design goes beyond the use of grammar and punctuation and seeks to find meaning in a functional way. The genre-pedagogy that started at the Sydney School (Rose & Martin, 2012, p. 321) is based on the understanding that language is goal orientated, i.e. it is important what the language "does for you", and that language is always related to a social context (Malinowski 1935; Wagner, 2015). Therefore, it benefits design-based education by guiding how pupils can use language in a functional way to present their design ideas.

Halliday (1976), who's language theory is incorporated into pedagogy, used the term **register** for particular language features that depend on the context of the situation. The register has three main concepts: the field (social activity of expressing ideas), tenor (roles taken when communicating ideas) and mode (channels of communication when sharing ideas). In this paper we focus on the field of design language. We analyze three specifications to present design ideas: The functional name (van Dijk & Hajer, 2018), problem-solution authentic scenario (Fox-Turnbull, 2018) and user feelings (Haven, 2007).

To foster the ability to develop the field of design language we use as reference the teaching learning curriculum-cycle suggested by Rothery (1995) It has 4 main stages:

1. Building the Field (getting to know the concept of a subject),
2. Deconstructing (teaching-led examples of a certain genre),
3. Joint construction (teacher and pupils collaborate to create a text using a genre),
4. Independent construction (learning evidence written by pupil using the genre taught previously).

This cycle has proven to be a powerful resource for supporting the literacy development (Christie & Derewianka, 2010; Gibbons, 2002; Humphrey, Macnaught, & Others, 2011; Knapp & Watkins, 2005; Rose & Martin, 2012). We use the genre-cycle as a strategy to focus on how students learn to present their design ideas.

In the design literature and in the practice of industrial design, we identified a number characteristics of design presentations. First of all, new design concepts are usually given a (working) title or name during the design process. Van Dijk (2018) explains that the artifact's name says something about the functional purpose of the artifact. Second, many design presentations follow a problem – solution structure. A problem or unmet desires in the current situation, is followed by a proposed solution(s). Third, unlike the language of science that highlights objectivity and frequently uses nominalizations (Christie 1998, Van Dijk 2012) and has an abstract nature (Van Dijk, Hajer, Scharten, de Vos 2013), designers use personal, subjective language (Eckert and Stacey 2000). Although designers may use descriptions and explanations – as the design is also grounded in science and research – a narrative approach is often at the foreground. This is clearly seen in storyboards that are visual representations of the design in its context of use over time (Van Boeijen e.a., 2013, p97) and in written scenarios (Van Boeijen e.a, 2013, p 99). Scenario's may contain a neutral sequence of steps but may also be written as a moving and epic narrative (Van Boeijen e.a, 2013, p 99). These elements of the genre of design presentations can be learned through the teaching learning curriculum cycle developed in the genre pedagogy.

Our main research question was: "How to support upper primary pupils in applying the specific genre of design language when presenting design ideas?" To answer this question, an educational design set-up was selected to understand the benefits of creating a learning environment to develop design language. A sports research group of The Hague University (HU) served as client and provided the design challenge. Their role in the learning process was to give the pupils a real problem within a context.

From session 4 to 6 we analyzed the language achievements in the pupil-led construction of their design presentation by answering the following questions:

- What was achieved in terms of supporting the pupil's ability to name a design idea?
- What was achieved in terms of supporting the pupil's ability to use the problem-solution authentic scenario?
- What was achieved in terms of supporting the pupil's ability to express the user's feelings?

2. METHOD

The set-up was developed in collaboration with a teacher at an International School in the Netherlands, and HU. The problem owner proposed to design the gym of the future as the design challenge for primary education pupils. The assignment was too broad and along with the PE teacher we decided to narrow it down to focus the challenge on three different types of users depending on what motivates them to move. The PE teacher specified three categories: leisure, competition, and fitness. These categories led pupils to create personas. They were asked to develop a sport activity for at least two different end users. The design was presented twice to the sports research group, halfway in session 4 and at the end of the project in session 6, to enable pupils to use the client's feedback in elaborating their design idea and to inform the client

The design project was implemented by the class teacher along with the PE teacher and at times supported by one of the authors of this article – in six sessions of two hours each. The class consisted of 20 pupils (aged 9 to 12) with different cultural backgrounds and various mother tongues. The project was conducted in English and although most pupils were fluent in English, a few number of pupils had a lower English level as they were new to the International school system. The six sessions followed the well known design-cycle, see figure 1.

In addition, we used the curriculum cycle from the genre-pedagogy and adapted it to our need to develop the field of design language (Figure 1). In the first two sessions the pupils conducted a teacher-led activity to characterize the genre-pedagogy applied in the case study and discuss the features of design language and how the end user of their design could prefer a certain reason to do sports like: leisure, competition or/and fitness. In session three, the teacher-led activity consisted of modeling by using a video from a Dutch television show "The best idea of Holland". Afterwards the teacher and pupils analyzed the video and deconstructed the features of design language in the presentation. Later on, they used a worksheet to start designing their sport activity. In appendix 1 we share the structure of the worksheet to support their design activity.

Afterwards, the pupils made a video of their first design for the problem owner. The problem owner sent feedback with an audio file. The teams were asked to answer a guiding framework that included the following questions:

What did you come up with?

What's the purpose?

Who is it meant for?

What makes it an original idea?

What do you think you could elaborate more on?

In session 4 the pupils listened to the audio and based on the feedback of the problem owner adapted their design. This help the students further to develop their design ideas.

Throughout the design project, the lessons were videotaped and pupil material was gathered and analyzed focusing on how children learn to present design ideas. The data was analyzed using the structure of the teaching learning curriculum-cycle and focused on three elements (naming, problem-solution structure and user feelings).

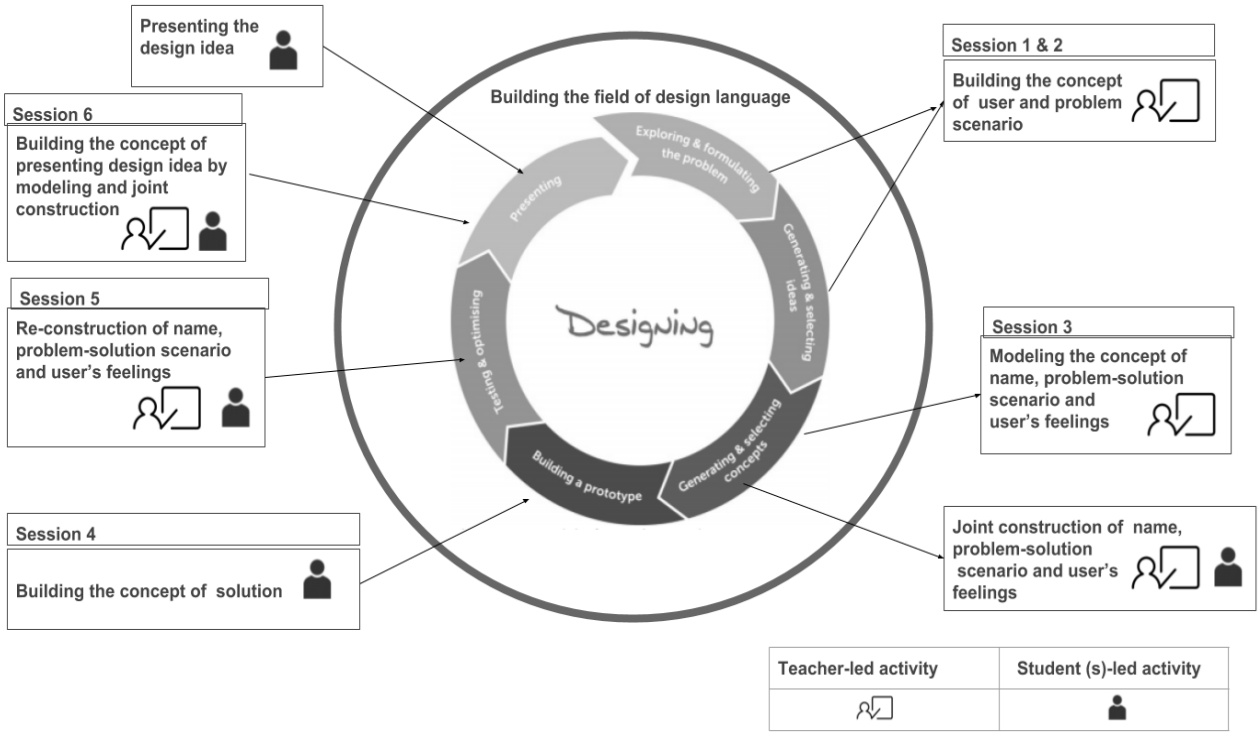

Figure 1. Building the field of design language

3. RESULTS AND DISCUSSION

The teacher used the curriculum cycle loosely to explain the features of design language. In the first two lessons of building the field of design language the learning objective was to harvest previous knowledge from pupils. For example, different reasons to move, different types of activities and gym facilities.

In session 3 the pupils watched a video that modeled a way to present a design idea. The video had different modes of communicating the problem-solution scenario. For example, the actress used gestures and role-play to express her feelings before and after using the design. After watching the video, the example was discussed with the whole class as illustrated in box 1.

Box 1

Teacher:
What was the challenge?
Student 1:
Why Nasa materials?
Student 3:
They are trying to convince people
That's not true (when at the advertisement they mentioned that they use materials from the NASA)
Teacher:
So what was the problem?
Student 1:
to make the it no so heavy.
The problem was that she was trying to carry something heavy
Teacher:
What did you notice then?
Student 2:
I noticed that they were talking about the NASA and materials from the NASA
Teacher:
Yeah, they did mention the NASA, why?

Student 3:
It did also say German quality, I don't know why?
Teacher:
Did they say that? Why did they say German?
Student 3:
Because want to say it's good quality.
Teacher:
What type of things come from Germany?
Student:
Cars, like Mercedes, BMW, Volkswagen
Teacher:
Generally speaking German things are good. One more.
Student ?:
Before she looked was sad and when she gets the thing she looked happier
Teacher:
Well spotted, there is a before and after, wasn't it?
Before she was all worried with this heavy thing and after she was happier with this German, NASA space bucket holder thing.

These led to a discussion in the class among the teacher and pupils where they were able to pinpoint the 3 key features of the design language.

In the next activity pupils used a worksheet enabling them to start elaborating their design idea. This highlights the joint construction to build the field of design language. We realized that it is fundamentally intertwined with the pupil-led construction of the final outcome. The tenor between teacher and pupils elaborating the design idea and refining the concepts as the main components was sometimes lead by teacher or pupil. The teacher questioned them in order to guide them towards a more refined elaboration of their design idea and presentation. The problem owner gave feedback that helped one of the teams to be more specific about their name, the pupils reacted positively to the feedback and build up on it to move on the next design phase.

What was achieved in terms of supporting the pupil's ability to name a design idea?

Four of the five teams were able to link the function of the design to their name in the final presentations. For example: "Carry the king", "Obstacle Monkey", "Exercise Tag" and "Colony". The other team decided to make a combination of words from the two games they were inspired by to make their game, they called it "Scrumble". In table 1 we present the evolution of the name during the design process.

Table 1. Name of the game in the intermediate and final presentation

Team	*Name intermediate presentation*	*Name final presentation*
1	*Dragon*	*Obstacle monkeys*
2	*No name mentioned*	*Colony*
3	*Carry the king*	*Carry the king*
4	*No name mentioned*	*Scrumble*
5	*No name mentioned*	*Exercise tag*

In the presentations in session three only two teams mentioned a name for their game. Whereas the name "Carry the king" was functional in showing the nature of the game, this was not the case with the name "Dragon" by the other team. This is shown by the name itself but also by the reaction of the problem owner to this design team "Can you say something about the name of the game? Why is it called dragon game?". As a result, the team changed the name later on to "Obstacle monkey". In the final presentations, all teams used an attractive name related to a core element of the game.

What was achieved in terms of supporting the pupil's ability to use the problem-solution authentic scenario?

During the final presentations four out of five teams describe a problem that is solved by the new game, for example.

> "Well it's not the same (kind of game) as usual. It's by two, but usually you just go run for fun, here's it's like a bit competitive" (Team: Obstacle Monkey)

> "The idea that there is also a strategy in a more competitive game, 'cause there are strategies in games like football but you don't really do that much of thinking but here you can like have a good time and know like first you grab this and then this one so this team doesn't intercept it so like that. Limited resources and limited time so that makes it hard, you have to think so good thinking and good precision, so without good thinking and good precision you lose." (Team: Colony.)

Although the problem is mentioned, the teams describe the problem very briefly. They do mention a fault with other games, e.g. "usually you just run for fun" or "you don't really do that much of (strategic) thinking". These remarks are rather abstract and no elaborated information about the problem is given, although they did give more elaborated information on how the solution looks and works.

In all the presentations the explanation of the problem within a context was interpreted in different ways. Three of the teams used similar characteristics such as relating it to the gym, and how two types of movers wanted to play a game ("Carry the King", "Exercise Tag" and "Scrumble). The team "Obstacle monkeys" turned the context of the gym into a Jungle. The team "Colony" explained the problem relating it to a medieval context and when they introduced the characters they were able to narrow it down by explaining the problem along with the characters.

All teams mention the solution found, the newly designed game, and describe how it works. For example,

> "Here you see over there is the map design of our game. So you can have four teams, or you could have more or less but this is how we are like designing our first draft and there are six pieces of territory lying around here and the goal of your team is to claim as much as possible. ("Team Colony")

> "Like carrying another person like in teams, they have to cross the lake as fast as they can and that's like a competition and it's fun 'cause they have to find a way to carry them the person without using hands." (Team: Carry the King)

When they were presenting orally, the pupils also used body language to explain how their design worked. Especially, when the problem owner was asking them questions after their final presentation, all the questions focused on elaborating more on how their design worked, so they were using role play, drama and gestures to elaborate more on their design idea.

What was achieved in terms of supporting the pupil's ability to express the user's feelings?

The five teams were able to introduce the characters as end users and the benefits for them. They were able to give a minimal description about them by explaining with which type of mover they identified (leisure, fitness or competition) but they were not able to focus on the feeling.

> For example: "To have fun and it's competitive and also fitness because you have to pick up the person, like competitive, fun and fitness and that game has the three of them, so that makes them more persons play it." (Team: Carry the king)

> "Because you can have fun and be fit at the same time" (Team: Exercise Tag)

Here the teams indicate that the game is attractive for more children because the game is geared towards leisure, competition and fitness, but no specific user experiences or feelings are communicated. The other team (Scrumble) mainly explains the game and how it is different from existing games, but do not describe user benefits.

All teams start their presentations with either a description of the designed game or with some abstract benefits for the potential users. The problem is only briefly communicated; the solution is explained in great detail, but the benefits for the users are not described by two teams or rather abstract by the three other teams. In the

intermediate presentation none uses a narrative timeline starting with the problem and then going to the solution, rather they all start with the solution and describe some benefits of their game.

During the final presentation they follow a story plot that helps them to elaborate on the narrative of their presentation. Only one of the teams was able to mention fun as one of the end feelings as a result of their design. Two other teams were more focused on finding audience acceptance as a way to consolidate and validate their design. They were also focused on the type of end user but not necessarily on their feeling. This gives room for improvement to support the learning process focusing on the empathic part of the design related to the user's feelings.

4. CONCLUSION

Throughout the design cycle the three selected features of design language – naming, problem-solution narrative structure and paying attention to user feelings - can be modeled or supported using the curriculum cycle loosely: for instance first modeling (teacher-led), then joint construction and pupil-led construction using features of the design language. As our case-study shows, a lot of modeling and supporting can be done with material from the design project the pupils are working on, making working on design communication authentic and motivating.

The narrative structure was used as the plot to present the problem-solution scenario and the pupils were able to accomplish it, although there was not enough elaboration of the user's emotions in their design presentation.

For future research there needs to be improvement of the intervention in this direction in order to support the learning process focusing on the empathic part of the design related to the user's feelings. It would also be interesting to consider an improvement in the key features of the pupil narrative to focus more on the problem-solution scenario.

The case-study also shows that pupils may also demonstrate to other pupils elements of the design genre as they spontaneously use and develop design language. The use of gestures, drama and prototypes was not modeled beforehand by the teacher, but good examples were spontaneously present. Especially, during the final presentation, when the problem owner asked them to elaborate more on how their design worked. The feedback process could achieve a full potential by also bridging the communication language that the problem owner uses to give feedback with the language the pupils are using to present their design ideas. We advise teachers to think of ways to make use of these occurrences so the class can learn from natural approaches of children when presenting their design ideas. Therefore, we stimulate the teacher to encourage pupils to present using body language and consider it as part of the final outcome when presenting their design idea.

A limitation of the genre-pedagogic cycle as a tool to support to design language is found in the fact that its set-up is primarily driven by language goals. The focus is on one specific genre and pupils learn about this genre by analyzing and applying the same genre over and over again while working on several topics. However, a design project focuses on one topic (in our case gym) and includes many genres (e.g. the genre of brainstorming, the genre of sketching etc). This contradiction was solved in the case study by introducing video's on other designs and by applying the genre-cycle loosely in the context of the design cycle. As a result a lot of modelling and support around design presentations was done with authentic material from the gym design project.

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7. APPENDIX

Category	Questions in worksheet
Naming the design	Name of the sport activity (make the title catchy and easy to pronounce)
Problem- solution scenario	Describe the sport activity: (purpose, how it starts, rules, how it ends)
	Why do you think it's a good sport activity? How does it help to raise the heartbeat?
	Highlight the details that make it a "new" sport activity:
	What type of materials do you need?
	Visual design of your sport activity:
End User	Who plays it? For which type of movers is it meant for?