

# How Students with different levels of Design Experience use PLEX Cards within the Brainstorming Process

Hans Brombacher\*  
Eindhoven University of Technology  
Eindhoven, the Netherlands  
j.g.brombacher@tue.nl

Rosa van Koningsbruggen†  
Bauhaus-Universität Weimar  
Weimar, Germany  
rosa.donna.van.koningsbruggen@uni-weimar.de

Panos Markopoulos  
Eindhoven University of Technology  
Eindhoven, the Netherlands  
p.markopoulos@tue.nl

## ABSTRACT

Design cards are gaining popularity as a way to represent and disseminate design knowledge. Simultaneously, related research has not yet examined how intended users experience their use. This paper evaluates how designers with different levels of experience use and experience the PLEX Cards. Following a mixed-methods research approach, we compare how junior and senior design students use and experience these cards. Participants in our study experienced the PLEX Cards through a brainstorm session. Our study ( $N=25$ ) shows that these cards offer structure, different perspectives, and help start the design process; junior students used the cards as intended and, experienced the design cards more positively than their experienced colleagues, who adapted the intended method of the card set to fit their way of working. Our findings support the expectation that design cards are more suited for introducing designers to unfamiliar design topics and can be a useful material for design education.

## CCS CONCEPTS

- Human-centered computing → User studies.

## KEYWORDS

Design cards, Design students, Design processes, Brainstorming, PLEX Cards

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## 1 INTRODUCTION

Design cards are a popular way to guide designers in the design process [29]. They are a low-tech, tangible, and approachable medium

\*Both authors contributed equally to this research.

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to aid ideation, inspiration, or to provide information [19]. Quite a few card sets have been developed by design researchers, covering various design contexts. Some of the best-known examples are the VNA (Verbs, Nouns, and Adjective) cards [10], IDEO cards [1], or the Inspiration cards method [8]. Furthermore, numerous potential benefits are associated with design cards: for collaborative design activities, the physicality of the cards means that they can be visible and accessible to all. Moreover, they provide a common language to heterogeneous teams [15]. The physicality of cards makes it easy to group them in different arrangements on a surface, making them a flexible shared representation [19] that can be used as tangible idea containers to support combinatorial creativity, or trigger collaboration.

However, a recent review of 155 design cards emphasized how little is known about how designers actually use design cards and what value they see in them [26]. Moreover, it showed that the evidence currently available comes almost exclusively from card-set creators. This review also called for empirical studies to document how cards are used and the value they provide in practice. This would give the designers of card sets insights in how their intended target group would use their cards. Knowledge which they can include in their designs. Furthermore, users would gain an understanding of when it is beneficial to implement design cards within their design process and how design cards can be used to facilitate their experience level.

To address this gap in research, we carried out an experiment that compared how junior (first-year students, which we from now on will refer to as Bachelor) and senior design students (Master students) approach a set of design cards, which they were unfamiliar with. Specifically, we asked design students to work with the PLEX (Playful Experiences) Cards [18] during a brainstorming session [27]. PLEX Cards is a card set based on the 22 categories for playful experiences [17]. The idea behind PLEX Cards is to facilitate designing playful experiences. The card set addresses a contemporary design challenge and is well-cited in related literature. Therefore, we asked participants to use the PLEX Cards in a brainstorm session, in which they had to come up with concepts to address a given design challenge. The setup of the experiment will be discussed in depth in the Method section. We hypothesized that the Bachelor students would reap most benefits from using the PLEX Cards [5].

Our results suggest that both groups experienced the use of a card deck positively, as the cards offered them guidance, a starting point, and new perspectives. We also found that Bachelor students experienced the cards more positively than the Master students, and

applied the method as intended. On the other hand, Master students adapted it to fit their needs and process. Our study contributes new insights in how different level design students use and experience design cards. This knowledge can be advantageous to designers, design students, and creators of future card sets, as it gives an understanding of how the intended user will use the cards and who benefits most from them. Before describing the experiment in depth, we discuss related work on the use and development of card decks within design research.

## 2 RELATED WORK

Through the years, multiple design card decks and related methods for supporting the design process have been developed, e.g. [1, 8, 10, 19, 20]. In an earlier review of design card research, Wölfel and Merritt identified and classified the intended purposes of design cards [29]. Here, they suggest that most of the surveyed cards can be used for general purposes, participatory design processes, or context-specific applications. Furthermore, they distinguish between card decks intended for use at the beginning of a design process, when needed, for specific points, or at any time.

Apart from case studies reported in literature, which introduce the cards and exemplify their intended use, empirical evidence which explores how people experience the cards and who benefit from them are limited. An example can be found in [6], which illustrated how different sections of the cards were used by designers and how cards could serve an analytical role. Moreover, [11] emphasizes how designers with experience adapt and incorporate design cards in a way that suits their process. However, in general, the empirical evidence regarding the use of cards is too limited for such claims. The little evidence regarding the uses and applications of cards tends to originate from the consultants or researchers who have created them [26]. This increases the need for further empirical research in independent studies.

## 3 METHOD

To address this gap in design card methodology, we examine the use of the PLEX Cards [18] by design students. We selected this card deck as it is intended to be used flexibly throughout the entire design process [12, 15, 29] and starting a session should take little time according to the creators of the method. An element which we considered helpful for the practical execution of this research. For our study, we used a convergent parallel mixed-method approach [4], with a focus on the qualitative data, gathered via semi-structured interviews. During the interview, participants were asked how they experienced the method, what they believe the strengths and weaknesses of the method are, the differences they perceived between a typical brainstorm session and a brainstorm session with the PLEX Cards, and whether they would use the method themselves and why this decision. With the participants' consent, the interviews were recorded, transcribed, and analysed using Thematic analysis [3].

In order to compare the two groups, quantitative data regarding the participant attitudes towards design cards was collected via a questionnaire. Participants had to rank their agreement on a 1 (agree) to 7 (disagree) Likert scale. The questionnaire consisted of

nine statements, which were grouped in three clusters. The clusters and corresponding statements can be seen beneath:

- (1) **Creativity Support:** (1) The PLEX cards were helpful during the brainstorm session, (2) I could use the PLEX cards to create interesting ideas, (3) By having the PLEX cards, it was easier to think outside the box, (4) The PLEX cards helped to communicate the ideas, (5) I would use the PLEX cards during future brainstorming sessions;
- (2) **Communication and Teamwork:** (1) The PLEX cards helped with the overall group communication, (2) I was able to share my ideas within the brainstorm session, (3) It was easier to share my ideas;
- (3) **Concept Development:** (1) The PLEX cards helped to go from idea to concept.

For the last question, participants had to rank the method (1 to 10). The quantitative data was analysed with SPSS 25.0, using an independent sample T-test.

Lastly, observations on how participants used the cards were made during the sessions.

### 3.1 Participants and Procedure



**Figure 1: Lab setting of the research setup**

Participants (N=25) were recruited using purposive sampling. The PLEX Cards were used in 11 sessions (6 Master and 5 Bachelor) by a total of 25 participants, whose demographics can be seen in Table 1. We recruited design students who are being educated in interaction design and for whom the specific method is relevant (Table 1). Furthermore, Bachelor and Master students were chosen, as the Bachelor students were just engaging in their first design project, whereas the Master students already had experience from numerous open-ended design projects. The participants worked in teams of 2 and 1 team of 3, as intended by the PLEX Card method. Each team consisted of design students with similar levels of experience (Bachelor or Master). At the start, participants were introduced to the design challenge, which told them to: *"Come up with a concept that makes people aware of their sugar intake and helps them to change their behaviour"*. The challenge was based on [2]. Participants didn't have prior experience with the challenge, although some of the Master students had experience with game design or design for healthcare. Having introduced the challenge, we explained the PLEX Card methods and shuffled the cards, after which the PLEX Brainstorming session started. Participants could express their ideas and concepts on a digital whiteboard (Figure 1). After 10 to 15 minutes, the PLEX Brainstorming session ended and participants had to choose one of their concepts to elaborate

**Table 1: Overview of the participant demographics**

	Master Students	Bachelor Students
Sessions	6	5
Number of Participants	13	12
Gender	7 female, 5 male 1 prefer not to say	7 female, 5 male
Age	M= 3.1 SD = 1.04	M=18.5 SD=0.51

on during the PLEX Scenario session, which lasted between 10 to 15 minutes. Afterwards, participants were interviewed about their experience and had to individually fill out the questionnaire.

## 4 RESULTS

### 4.1 Qualitative Data Analysis

Two researchers analyzed the data inductively; each created 30-50 codes of their own. After discussing and combining, twenty codes were defined and organized in six overarching themes. Except for one (session M1), all interviews were conducted in Dutch (the native language of most participants). Quotes from these interviews were translated as literally as possible. Before each quote, the experience level is stated ("B" for the first-year Bachelor students and "M" for Master), session number, and participant indication. The themes are presented separately for Bachelor and Master students.

### 4.2 Bachelor Students

**4.2.1 Perceived Positive Elements of the Method.** The Bachelor students suggested four positive elements:

- (1) The PLEX Cards method facilitates a quick start: *B6P1: "you don't have to start from scratch."* and *B11P2: "we could now start rather quickly. And I know that with a normal brainstorm, [...] you need some time to get in the flow. Whereas here, you quickly have something extreme, which you can work with."*
- (2) The method offered guidance and structure: *B8P1: "It is structurally more varied. Because often, with a normal brainstorm, you go everywhere"* and *B8P2: "you have to build further upon each other and the cards demand that from you."* and *B7P3: "you are guided much more, because normally you would first explore what you would do and now there is only one thing that you can do."*
- (3) The PLEX Cards demand an open mindset and exploration of elements which would normally not be considered: *B10P1: "They are all different points of view than that you would normally come up with yourself, so that is positive."*
- (4) Interestingly, the Bachelor students described the method as providing input "from the outside". One participant even described it as input coming from an extra person: *B10P2: "as if you get input from an extra person which you normally wouldn't have."*

**4.2.2 Perceived Weaknesses of the Method.** The first-year students named two drawbacks of the method. First, some cards were not useful: *B10P1: "it was sometimes difficult to link certain cards and [...] some cards don't fit each other. The last card, for example, I thought*

*we couldn't do anything with."* Second, the ideas generated by the cards were not always found feasible: *B11P2: "the ideas which we generated now are all somewhat more extreme ideas than the initial idea, so I don't know whether they are really usable."*

**4.2.3 How and When to Use.** Out of the twelve Bachelor students, eleven mentioned that they would like to use the method in the future as intended, at the start of the design process. Even the one person who wouldn't use it directly, mentioned she would like to use it as a back-up plan: *B6P1: "Yes, especially when you get stuck. Because with my project we experienced a dead end once or twice and there was no one who kept structure, and I think the cards can help with that, with giving structure to your meeting."*

### 4.3 Master Students

**4.3.1 Perceived Positive Elements of the Method.** Regarding the positive elements, the Master students concurred with the Bachelor students on several points: the method opens up different perspectives, offers guidance and structure, and helps to start the creative session. Besides these, the Master students mentioned three extra elements:

- (1) The PLEX Cards create a common ground during a brainstorm session: *M4P2: "So it gives you a common ground, everybody knows what they are doing".*
- (2) The method limits you, hence inspires you. This was seen as both a positive and a negative element.
- (3) The PLEX Cards helped the participants to visualise their thinking process: *M1P1: "with other brainstorm sessions it is always like you go from one idea to another [...]. With this [...] you can see where you started, especially when you write it down, and where it finished."*

**4.3.2 Perceived Weaknesses of the Method.** For the Master students, the perceived weaknesses were:

- (1) The method limits you: *M9P1: "A weakness is that the interpretation of the card is already partly on the card"* and *M5P1: "it is very restricting because you have to keep coming back to those cards."* and *M9P1: "the images on the cards influence the direction that you are thinking of [...] now, I immediately thought about physical relaxation, whereas that wasn't applicable to our concept"*
- (2) The lack of control over the design process. Several Master students asked what would have happened if they had drawn different cards: *M1P2: "If I would have picked other cards, we maybe would have a completely other idea [...] if I would use something like this, I would just like to have insights in everything. Because now I feel like I'm missing out on a lot of concept opportunities"*

**4.3.3 How and When to Use.** The Master students don't want to use the PLEX Cards as intended. Instead, they want to use them when experiencing a stalemate. Moreover, they would like to use it for other purposes than generating ideas. For example, using the method to communicate with others: *M9P2: "it would be a really good method for when you are working with people who aren't used to brainstorming"* and *M3P1: "I would use it to start a discussion, to for example find a problem within an organisation. Because people often*

**Table 2: Overview on the mean score of the three Likert scale (1-7 Agree-Disagree) categories**

	Bachelor (mean)	Bachelor (std)	Master (mean)	Master (std)	sig	t	sig 2-tailed	Cronbach's alpha
Creativity	1.90	0.775	2.99	1.269	0.001	5.144	0.000	0.725
Communication	2.47	1.000	3.08	1.403	0.142	2.134	0.036	0.514
Concept	2.67	1.557	3.69	1.251	0.483	1.823	0.081	/
Overall	8.00	0.739	6.85	1.144	0.221	-2.968	0.007	/

*have trouble mentioning the problem. Or they don't have any trouble with it and immediately mention everything, but this way you have control on that.*" Furthermore, one Master student mentioned they would use the method for pressure cooker sessions (where creative activities are capped to a very short duration as a way to stimulate creativity).

Nevertheless, while the Master students wanted to use the method slightly different than the prescribed version, they agreed that it is most suited for the start of the design process: *M2P2: "I think that during this part it was still positive. Let's say, during the concept phase it is positive, but at a certain moment you will need it less and that it then becomes, that when you are converging towards something, useless."*

#### 4.4 Quantitative Data

The quantitative analysis examined whether there are differences between the Bachelor and Master level industrial design students regarding how they experience the method. The analysis was based on the questionnaire responses. Cronbach's alpha (when applicable) was calculated to measure the internal consistency of the items of the different constructs. A summary of these results is shown in Table 2.

#### 4.5 Observations

During most sessions, one participant would take a leading role: taking the initiative, writing on the board, and structuring the session. Furthermore, some sessions adhered to the methods as introduced in the paper (e.g., PLEX Brainstorming and PLEX Scenario), these were mostly sessions with Bachelor students. The sessions with Master students resulted in adaptions of the method.

### 5 DISCUSSION

Our results suggest that first-year students experienced the design cards more positively than Master students within an ideation session. One explanation for this could be that the more design expertise one has, the less they need to rely on tools or aids to support design processes. In our case, the Master students had already developed their own methods for starting a design process. Wölfel and Merritt [29] concur with this observation, quoting John Zimmerman: "*designers often develop their own methods or appropriate widely known methods to best suit their needs*". Mumford et al. [24] describe how creative thinking improves when people use appropriate strategies. Due to the Master students prior experience, they have already started to develop appropriate methods themselves. It appears that first-year students benefit most from using design cards, as it helps them to choose an appropriate method. One

could expect similar differences to be observed for different groups, e.g., less and more experienced designers, and with different tools. Future research will need to examine these possible implications, by comparing different card sets and different levels of expertise of designers, including experienced professionals. Moreover, both our study, and the work of [7] and [13] show that with experience, designers start to adapt methods. Instead of following the protocol, the method is used for its concept. Furthermore, there is even a negative correlation between experience and the usage of design methods [7]. Therefore, we believe future research should focus on the development of methods that designers can use freely, by letting the user decide how and when to use them. Allowing designers the freedom to adapt the method to their process.

Next, the Master students had more confidence in the ideas generated with the PLEX Cards method than the Bachelor students, who worried that their ideas wouldn't be feasible or would be too absurd. For example, only two Bachelor sessions resulted in 'out of the box' ideas, which participants experienced as a weakness of the method. Master students didn't express similar concerns, even though their ideas were no less 'wild'. This could be because they have a better understanding of the technical feasibility or because they welcome wilder ideas in an ideation process, deferring concerns about technical limitations. Furthermore, Master students already have knowledge about existing projects and concepts, which they could rely on for concept combination. The importance of knowledge to creative thinking has been emphasized in numerous studies (e.g., [9, 25]). However, the type of knowledge that contributes to creative-problem solving is acquired slowly through increasing expertise [28]. First-year students are just starting to gain experience and knowledge, which they can later on use for creative thinking. Furthermore, the importance of believing in the feasibility of the ideas has been shown whenever people think positively about the execution of the idea, which benefits creative thinking [16, 23].

Furthermore, compared to the Bachelor students, the Master students had better-articulated opinions on the method. They knew which part of the method they liked or didn't like and had an opinion on how they would use it differently. Moreover, they tended to be a bit more hesitant towards actually wanting to use the method. Another difference noted between the sessions regarded differences in how the session groups organized their work, such as someone emerging as a leader. It is interesting to investigate with future research how such behaviour emerges and whether the group dynamics can be influenced by the design of the card set.

Regarding the appearance of the PLEX Cards themselves, we noted how participants commented on the design of the cards and

found some design elements confusing. For example, during multiple sessions, there was confusion regarding the title, description, and pictures on the PLEX Cards. Given the growing popularity of cards as a medium for conveying design knowledge it appears interesting to examine how to best design cards, to ensure they are effective and appealing [21, 29]. Currently, researchers who design such cards, are mostly focusing on their content, purpose, and applications. Future research could empirically evaluate the visual design aspects of cards, in order to guide future creators of card decks.

## 5.1 Limitations

A limitation of this research concerns the controlled nature of the experiment [14]. The challenge given to the students was relatively open and straightforward, as was stated by some participants. Future research should focus on the implementation of PLEX Cards in an actual design process [22]. Moreover, a larger group of designers could help ensure sufficient statistical power and give a better understanding on how the PLEX Cards are experienced within the design practice. Lastly, while the PLEX Cards were chosen for this research, we would like to understand how design cards are used in general. For this, similar studies should be conducted, using other card decks/methods and comparing different groups of designers, in order to assess the extent to which similar results might be found.

## 6 CONCLUSION

We set out to examine how designers use and experience design cards. Prior research has given an indication of why and how cards work and suggested that they might be useful for design education. However, there is a lack of empirical studies regarding how card decks are used, especially how designers' experience might influence their attitudes towards and usage of cards. Our contribution is to examine the use of the PLEX Cards [18], and provide empirical evidence on how students with different levels of experience perceive the use of PLEX Cards during a brainstorm session. Our results indicate that all students experienced the cards positively, reporting that they offered a starting point, guidance, and that they helped with the exploration of different perspectives. While our expectations and qualitative data indicate a more positive attitude towards the cards by the Bachelor students, this difference was not reflected in the quantitative analysis. Furthermore, depending on their level of experience, students used the cards in different ways: Bachelor students used (and want to use) the cards as intended, whereas Master students changed the method to suit their own approaches. Moreover, Master students want to use the cards when they are stuck or seek a new and/or different perspective. The findings of this study can be used by design students, designers, lecturers, and creators of future design cards, as the result provides insights in who experiences the use of design cards as most beneficial.

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