

ROLL THE DICE, RANDOM QUESTIONS IN THE MIDDLE

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ABSTRACT

Reflection is widely recognised as a powerful mechanism for deep learning in engineering and design education. "[It] stimulates people to 'own' their learning, which again stimulates the intrinsic motivation to apply lessons learned." However, in practice, reflection is often treated as an afterthought and, increasingly, outsourced to generative AI tools, reducing its authenticity and impact.

This paper explores an inclusive and engaging approach to reflection within different bachelor and master courses at Industrial Design Engineering. In these courses, student teams collaborate on complex design challenges. While technical skills are essential, team performance and collaboration are more critical to success. To support this, we have developed and implemented a set of coaching tools aimed at improving team dynamics and fostering equitable participation.

One tool that has proven particularly effective is the 'Reflection Dice', a simple and playful method for stimulating dialogue and self-awareness within teams. By rolling a dice, students are prompted to share insights on topics such as collaboration, progress, and personal contributions. The dice has been used in various contexts, and the activity should create a safe space for reflection, encourage diverse perspectives, and strengthen team cohesion, but this has not been tested yet.

In this paper we have researched the effects of the dice on these aspects. We executed a mixed-method study, where data is collected through surveys from students and faculty members. The results will be presented in this paper.

Keywords: Collaboration, team dynamics, dialogue, reflection

1 INTRODUCTION

In the IPD master's course Products Now Design Studio (PNds), students cooperate in design teams on a client-based design project for one semester consisting of 10 European Credits. PNds is a core design course within the Integrated Product Design master's programme at the faculty of Industrial Design Engineering (IDE) at the Delft University of Technology (TUD). Students collaborate in teams which differ in nationality, prior education, and socio-emotional development on a client-based and highly complex project [1]. The diversity between team members can lead to complications within the team due to miscommunication, frustration, and sometimes interpersonal conflicts. These complications often lead to lower performance due to the inability of the team and the coach to dealing with these complications constructively.

To improve learning and working in dynamic teams, reflection is widely recognised as a powerful mechanism for deep learning in engineering and design education [2]. "[It] stimulates people to 'own' their learning, which again stimulates the intrinsic motivation to apply lessons learned." [3]. However, in practice, reflection is often treated as an afterthought and, increasingly, outsourced to generative AI tools, reducing its authenticity and impact [4]. Within the Products Now design course we introduce students to "reflect as a designer" consisting of a lecture given by one of the authors and methods to do this correctly. The lecture introduces them to the importance of reflecting, different ways of reflecting using the Kolb's Experiential Learning Cycle [5], the Reflection Cards [6] based on Bateson's framework on logical levels of learning, Reflection with Proverbs [7], and other methods neatly summarised and described in the "Reflection Methods" book written by Femke Gordijn et al. [3].

To help the process of becoming a team, executing the work, and reflect on team and individual performances, we have researched team-performance in previous years [1,8-10] and published our learnings in our book "Connect: The Secret Formula of Coaching Design Teams" [11]. Next to our learnings the book also includes 12 educational activities and tools which can help in all three stages of

the project from start, run, to finishing an engineering project. One of the activities is reflection using the in-house developed Reflection Dice (RD). A simple, safe, and fun tool designed for team reflection, but it works just as well for individuals at the start, during, and finals of a project. Simply 3D-print it, roll it, and take a moment to reflect on your project, your collaboration, or even the meal you just shared (Figure 1). Rolling the dice is all it takes to spark meaningful thoughts and conversations [12].



Figure 1. On the left the 3D printed dice, in the middle the dice in action with two volunteers, and on the right the book chapter with instructions on the use of the dice [12]

We believe the dice is very helpful in getting meaningful conversations, but this is mainly based on observations and our first hunches. To confirm our hypothesis of the effectiveness of the dice as a tool to do meaningful reflections, we have researched the effects of the dice on these aspects by answering the following main research question:

- MRQ: How do users of the RD experience the dice as a tool within team reflection?

With the following sub-questions:

- RQ1: What are the current experiences of the participants when using the RD?
- RQ2: How effective is the RD for team reflection?

We executed an explorative mixed-method study, where data is collected through surveys from students and faculty members. Section 2 will present the Reflection Dice and discusses the activity of reflecting using the different sides of the dice. In section 3 we will present the design of the survey and the approach to answer the main research question. In section 4 the results are presented, and section 5 will discuss the results which leads to the conclusions of this research.

2 DESIGN OF THE REFLECTION DICE

Reflective learning involves stepping back from an event or experience to analyse it from different perspectives. In doing so you relate it to earlier experiences and discover meaning. It requires taking time to think, feel and digest, and it concerns identifying lessons learned. These are discussed and prioritised to be integrated into a strategy for action to improve future performance. In 2022 we started using the Reflection Cards [6] taken from the “Reflection Methods” book by Gordijn [3]. We noticed that students executed the exercise, often individually, without going deeper into the questions asked, they answered questions without thought.

To increase engagement and depth of reflection, the reflection cards were gamified in 2024. We developed the 8-sided reflection dice, first as a folding plate [11], later as an open-source 3D printable [13]. A key strength of the dice-based reflection tool is that it structures the process as a guided conversation. It prompts emotional, cognitive, and physical reflection, and it concludes with concrete “next steps,” like the action-planning stage in Gibbs’ reflective cycle [14]. Engaging in a dialogue with others enables the person who is reflecting to retrieve experiences more effectively, because the interviewer can probe, clarify, and encourage deeper exploration. This level of recall and depth is far more difficult to achieve when reflecting alone. The gamified format also reduces the sense of “having to reflect,” which many participants resist and therefore tend to approach superficially. This dice is designed for team reflection, but it works just as well for any reflection. Simply print it, roll it, and take a moment to reflect on your project, your collaboration, or even the meal you just shared. One roll is all it takes to spark meaningful thoughts and conversations.

At least two persons sit or stand around a table and decides to discuss how the team performed so far. One participant rolls the dice and the symbol that faces upwards symbolises the one to share with the group. The team member shall answer the question on the spot in a few minutes. It helps to make one participant the ‘facilitator’ to ask the question or support finding an answer. All team members roll the dice in turn. If needed, you can do a second or third round.

The dice consists of 8 sides, with eight different symbols: brain, thumbs up, key, heart, puzzle, hand, foot, and camera. Figure 2 shows these symbols including the concerning question(s) which are asked by the interviewer, when the side is rolled. The interviewee answers the question, while the interviewer is expected to deepen out the answer by using Who, What, Where, When, Why and How (5W1H) questions. 5W1H is a method used to obtain a thorough understanding of the situation which is described by the interviewee in their answer.



Figure 2. The 8 different icons on the reflection dice together with the questions to be asked

3 RESEARCH DESIGN

We have used the reflection dice on several occasions. In the first place during the PNds course, but also in several other bachelor and master design courses, social-safety workshops for TU Delft employees, during graduation projects, or just for fun in social events.

To address the research question, an online survey was developed and administered to students from several bachelor and master courses who have used the dice to reflect on their work individually and as a team. In addition, it was distributed to potential users inside and outside the programme through email and various social media channels.

The survey consists of 9 questions, of which the first two are related to the status of the participant (question 1) and in which context the dice was used (question 2). Question 3 comprised quantitative items measured on a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree.' These items address (a) the perceived usefulness of the dice, (b) comfort in sharing, (c) engagement, (d) enjoyment, (e) anticipated future use, and (f) preference for alternative reflection methods or tools. In Question 4, participants were asked to indicate their preferred side of the eight-sided dice. The survey was finalised with five open-field questions where participants can describe their experiences while using the tool (question 5) and the insights they acquired during this process (question 6). Question 7 and 8 relate to the recommendation and prohibitions of using the dice in the future. The final question is an open-comment box.

The questions having Likert-scale scoring options will be summarised into general trends using frequencies and distribution patterns for all participants in the survey.

The open qualitative questions were analysed using Thematic Analysis [15]. For this we selected only those responses which were entered by bachelor or master students when used within a team context. All responses were imported per question into Claude.ai (Haiku 4.5) to identify the key themes related to participants' experiences (questions 4 and 5) and the effects of the dice (questions 7 and 8). Subsequently, all responses were individually reviewed and assessed by the authors to ensure accuracy, authenticity, and alignment with the identified themes. Responses to question 4 and 9 were limited and therefore excluded from this research.

4 RESULTS

In total, 68 responses were collected: 29 from bachelor students, 34 from master students, and 5 from employees or master's alumni. The dice-based reflection tool was used on multiple occasions, with some participants engaging with it more than once. It was applied 58 times during team evaluations within a course, 19 times for individual reflection, and 9 times for general team evaluations. Additional uses included social-safety meetings (3 instances) and informal or social settings (3 instances). To answer the main research question of the effectiveness of the dice in a student team environment, we will focus

mainly on group reflections within our bachelor and master student teams. This relates to 44 responses out of the total 68.

4.1 Quantitative data analysis

Question 3 consisted of six statements where the participants are asked to indicate their level of agreement with them (Figure 3). The findings indicate an overall positive perception of the dice as a means of supporting reflective practice for all participants in the survey.

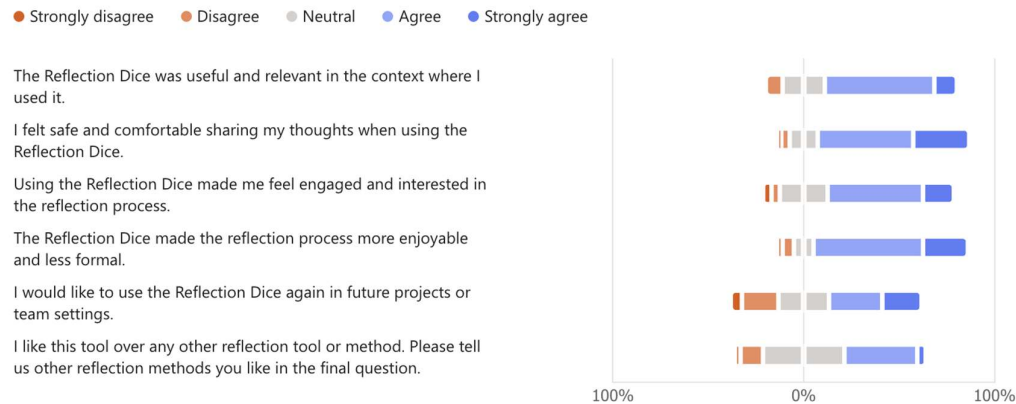


Figure 3. Responses to the six quantitative questions using a 5-point Likert scale for all 68 responses

4.2 Experiences

For the thematic analysis of the experiences the responses of only question 4 and 5 are used:

4. Please describe your experience, what happened during the process of using the Reflection Dice in your context?
5. What insight did the dice give you or what did this reflection process bring you?

The analysis was conducted on 44 responses from bachelor's and master's students reflecting within a team context. Overall, 70% of the responses were classified as positive, 20% as neutral, and 10% as negative. In total, 11 themes were identified. Table 1 presents the five main themes, each occurring in more than 20% of the responses and all classified as positive, along with the most prominent neutral theme which occurred in 18% of the responses.

Table 1. Overview of the key themes from the experience analysis

Theme	Explanation	Quotes
Enhanced communication within the team	The Reflection Dice successfully facilitated conversations that might not occur naturally.	"The dice allowed for random choice of subject, which made it easier to answer spontaneously, without over-preparing our answers" (ID 14)
Deepened relationships and mutual understanding	Participants gained deeper insights into teammates and felt greater connection.	"We learned a lot about each other, not just related to the team project but also otherwise" (ID 36)
Structured and guided reflection	The Reflection Dice provided an appreciated structure and direction for reflection processes.	"Using the dice structured the reflection in a good way where it was not just mindless reflection but more focused" (ID 48)
Fun and engagement	The playful nature of dice-rolling made reflection feel less formal and more engaging.	"The Dice helped to make the reflection less formal and fun" (ID 13)
Spontaneity and honest responses	Random selection reduced preparation and encouraged more authentic responses.	"When I threw the dice, I got an option that I wouldn't have picked as a conscious choice." (ID 53)
Context-related effectiveness (neutral)	Effectiveness significantly depended on pre-existing team dynamics and context.	"It didn't bring any new insights. Our team has a nice work environment"

		and we like to spend time with each other" (ID 35)
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4.3 Recommending the dice

The same thematic analysis was conducted as in the previous chapter but now focussing on the recommendations for future use. The experiences the responses of only question 7 and 8 are used:

7. Why would you recommend this tool to someone else?
8. Why would you not recommend this tool to someone else?

The analysis again used the 44 responses of only bachelor/master students reflecting within a team context. Of these, 31 participants responded to question 7 and 26 to question 8. The three main themes for recommendations both in favour and against are presented in table 2.

Table 2. Overview of the top three themes in recommendations for the dice

Recommend for	Explanation	Quotes
Informal and gamified approach	The informal and playful nature of the tool is identified as a distinctive and valuable strength.	"Because it makes talking to each other easier. Most engineers don't talk about their experience easily; hence this gives them a little stepping stone and inspiration" (ID 49)
Structured guidance and framework	The tool provides crucial structure that guides reflection and eliminates cognitive burden.	"It helps a lot to steer the conversation. You don't need to come up with topics for discussion yourself." (ID 2)
Ice breaking and accessibility	The tool is particularly effective for teams struggling with natural communication.	"It can help break barrier with teams which feel awkward and resistant to communicating without a structure" (ID 32)
Recommend against	Explanation	Quotes
Prompt clarity issues	Several prompts lack clarity, are overly broad, or generate confusion about what response is expected, leading to awkward or blank answers.	"The questions themselves are still very broad, which can still lead to blank answers, awkwardness, and sometimes even desire to switch questions." (ID 14)
Restrictive design	The rigid structure of sticking to one topic at a time prevents participants from discussing what is actually on their mind.	"There is a chance that you roll for instance: Camera but really wanted to say something about Puzzle." (ID 13)
Problems with forced reflection	Some participants object fundamentally to structured or mandatory reflection.	"Forcing then to stick to one method of reflection made it seem like a chore. The true points of reflection came in between the actual points of the tool." (ID 8)

5 CONCLUSIONS AND DISCUSSION

The quantitative results show that participants generally perceive the dice-based method as a positive and engaging way to support reflective practice. The dice enhanced communication and discussion in a structured and guided way. Next to that it was also seen as an engaging way of reflecting, making it less formal and more fun. Participants valued sharing experiences within their teams, noting that the tool stimulates reflection through dialogue rather than through individual, checklist-like tasks. Not all respondents consider it the preferred option for future use, either of dislike for reflection but also when it is used in contexts where the team is already functioning correctly, there it might feel not adding value. RD is seen as a playful way that sparks dialogue, especially within silenced teams or in conflict resolution. It facilitates discussion and even brings forward problems, but it does not resolve the underlying conflict. The authors acknowledge this, dysfunctional teams might appear from the RD session, but need different follow-up steps like, for instance a structured dialogue session [10,11]. The icons and prompts sometimes are seen as restrictive and lack clarity. This sometimes leads to awkward

feeling and time-inefficiency, and highlights the importance of having clearer instructions, introducing the participants to interviewing techniques using structured probing (5W1H), or even introducing an external facilitator to further enhance its effectiveness, especially when used first time. Overall, the findings suggest that most students benefit from this playful format to spark conversation and for teams that struggle with team dynamics. The dice method appears to foster interpersonal dialogue, empathy, and stronger group relationships, qualities that many traditional reflection tools do not inherently promote.

6 RESEARCH ETHICS STATEMENT

The survey was conducted in accordance with the TU Delft Regulations on Human Trials [16]. Participation was voluntary and all participants were asked explicitly for their consent to use their feedback “in the analysis and [...] quoted anonymously in the paper”. Data is acquired anonymously using a survey made in Microsoft Forms without login. No personal data is retrieved or stored in the database. Open-ended questions were not obligatory and all text referring to any personal identifiable information is taken out before analysis. This paper was made using artificial intelligence tools for text and grammar support (Copilot, GPT-5.1) and for qualitative data analysis we used Claude.ai (Haiku 4.5) to assist in theme suggestions for the thematic analysis.

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