

EVALUATION CRITERIA FOR NEEDS STATEMENTS IN DESIGN EDUCATION

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ABSTRACT

Problem definition is essential to develop innovative products. The needs statement is a framework expressing design problems or user needs in a single sentence. In design education, needs statements are sometimes used to teach problem definition. Many novice students who do not major in design struggle to generate the needs statements and to understand key criteria. On the other hand, educators seem to have standard evaluation criteria. As a first step to effectively supporting design learners in writing needs statements, this study aims to identify design educators' evaluation perspectives for needs statements. Semi-structured interviews with nine educators and qualitative content analysis were conducted. The results revealed an evaluation perspective on the function and quality of the statement. The five perspectives for evaluating the function of the statements are **Adequacy of expression, Consistency with the theme, Whether it is based on research, Feasibility of idea generation, and Consistency with the solution**. The three perspectives for evaluating its quality are **Newness, Clarity, and Efficacy**. The results corresponded to the criteria of idea creativity evaluation. Although these results were obtained in a limited context, it is expected to be the basis for supporting students' activities on framing, problem definition, and user understanding in design projects.

Keywords: Problem definition, needs statement, user understanding, user research, empathy

1 INTRODUCTION

Designing is an iterative process of divergence and convergence, moving back and forth between problems and solutions. The Double Diamond Model (Design Council, 2019) describes the process in four stages: *Discover, Define, Develop, and Deliver*. The model described the process as a series of steps with no clear distinction between each step. Designers have taken a variety of strategies and approaches to generate solutions to unstructured and open-ended problems, and several kinds of literature have studied the process of individual activity in design (Abidin et al., 2008; Ito et al., 2022; Murray et al., 2019). Based on the literature, essential factors in generating innovative ideas are recognising, framing and defining user needs.

Much research has been conducted on problem definition and framing. Abduction, known as one of reasoning, is essential for generating creative solutions (Kolko, 2010). Dorst (2011) states that framing is a core practice among abductive reasoning methods and that research should be conducted to understand it in more detail. Several studies have been conducted to understand the activities of individuals in problem definition. For example, experts have comprehensive mental representations based on broad relevancy perception (Björklund, 2013). Another research found that problem framing has influenced idea generation (Wright et al., 2015).

Design education for non-designers aims to teach the designers' approach and mindset. Since there are many obstacles in defining design problems, a framework called the "needs statement" is used (Lewrick et al., 2018; Stickdorn et al., 2018). Needs statements are expressed, for example, in a format of "{who} needs {what} because {why}." This statement expresses in one sentence which users are targeted, what kind of needs users have, and why users need solutions to let users achieve their needs. This statement includes "insight" gained through user understanding. The statement also indicates the results that need to be achieved by the solution and the requirements met by the solution, which serves as a starting point for idea generation. Despite this critical role in the process, it has been found that students experience many difficulties writing needs statements (Loweth et al., 2020).

While several studies of the problem definition exist, there is a lack of clear guidelines in design education for needs definition. There is a need to identify guidelines in educational settings to develop effective strategies and approaches for learners. In particular, there needs to be more research on needs statements, although they are used in many educational fields. Educators have shared clear evaluation metrics for needs statements based on good/bad cases from experiences. Clarification of these guidelines could lead to improvements in design education.

This research is the first step to effectively supporting design learners in design education. This study aims to investigate the perceptions of educators involved in design education regarding problem definitions. The research question of this paper is “What are the evaluation perspectives of the needs statements of educators involved in design education?” and “What kind of content do educators evaluate and how?” Semi-structured interviews were conducted with nine interviewees involved in design education, and the interviews’ content was analysed qualitatively.

2 METHOD

This study conducted interviews and analyses to determine the perceptions of educators involved in design education regarding problem definition.

2.1 Backgrounds of Interviewees

Figure 1 shows the backgrounds of the interviewees. The interviewees of this study were educators involved in design projects and project-based courses for innovation creation offered at Japanese universities. Projects they are involved in are also for university students who do not major in design to learn about design approaches and mindsets to create. Since there are differences in framing approaches between different cultures in different countries (Lotz et al., 2014), interviewees were selected in a limited context. Seven of the nine had been involved in a project-based learning course at the authors’ university for two to seven years as educators, one had an arts background, and the rest had engineering backgrounds. In the course, teams of engineering graduate students and third-year undergraduate art students work together using a user-centred design approach. In the project, a partner company gives a theme, and teams aim to develop a product on the theme in five months, as done in the ME310 at Stanford University (Carleton & Leifer, 2009). Two of the nine interviewees not involved in this project were also involved in similar innovation projects as educators. The two interviewees were included to generalise the results to design education for engineering students in Japan.

2.2 Semi-structured Interview

Interviews were to investigate the perception of educators on problem definition or evaluation perspectives of educators on needs statements. The interviews were exploratory, focusing on characteristics of good and bad examples of problem definition from past projects, the role of problem definition in design processes, and common mistakes made by students (Figure 1). Each interview lasted thirty minutes to an hour, and all dialogues were recorded. The first author conducted all interviews. Because it was a semi-structured interview, interesting responses were explored in depth.

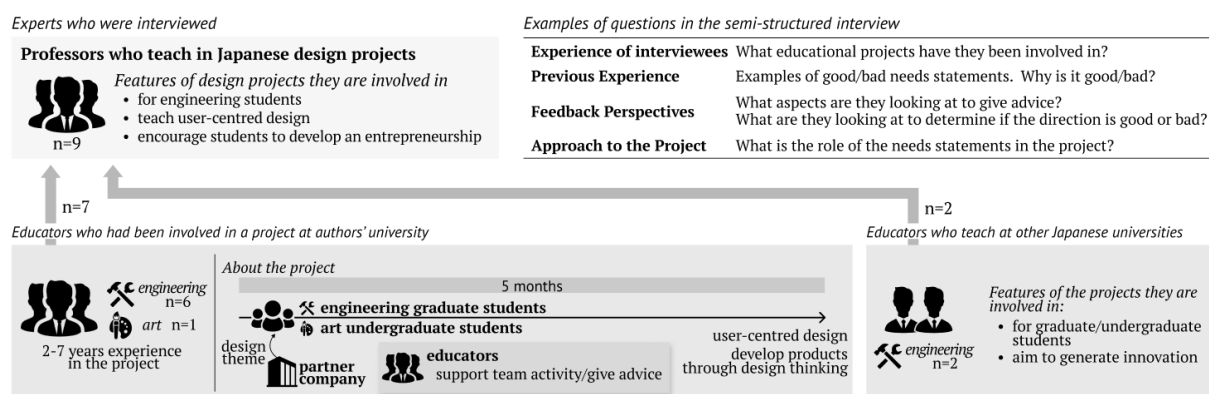


Figure 1. Backgrounds of interviewees and examples of questions in the interview

2.3 Qualitative Content Analysis

All recorded interview dialogues were transcribed, and the content analysis was conducted following Mayring (2021), as shown in Figure 2. First, the first author read the transcribed content several times to become familiar with the data. Next, statements relevant to the problem definition were identified and extracted. Then an inductive coding approach was used to interpret and conceptualise the transcriptions. This process was repeated, adjusting the meaning of concepts and the level of abstraction. Those concepts were merged when concepts overlapped, and when new structures were found, concepts were subdivided. Integration and subdivision were continued until saturation was reached, and finally, the results of the interviews were structured. After structuring, the two authors discussed and confirmed the definitions, agreed on all definitions and concepts, and completed the content analysis with a final confirmation.

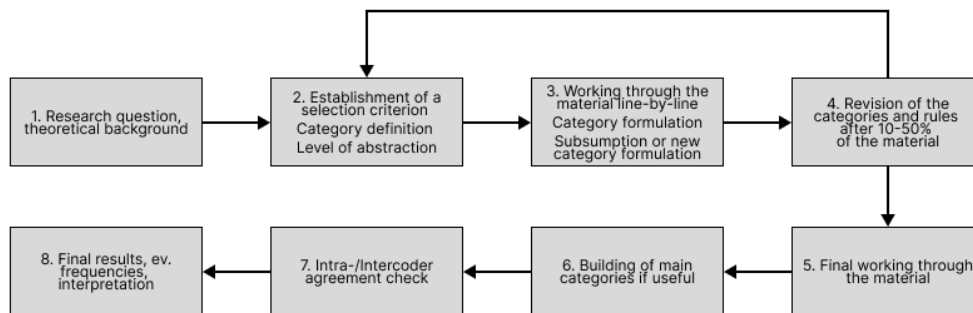


Figure 2. The procedure of content analysis (Mayring, 2020)

3 RESULTS

The content analysis generated concepts about the evaluation perspective on needs statements. The interviews contained much of the same content regardless of the project in which the educator was involved. Therefore, it was possible to exclude project-dependent stories from the analysis and only include general content. This section describes the fact revealed from interviews and the concepts generated from the analysis.

It was revealed that educators instructed the students to prioritise the development of a solution rather than expressing the needs statements. Interviewees all mentioned that it was impossible to determine whether the process would be successful based on the need's statements alone. When educators evaluate the processes students conduct, it is essential to evaluate them based on overall outcomes, not only needs statements but also the ideas presented, the proposed experience with the prototype, and the results of user tests. However, educators mentioned that the signs of typical failure may be discerned from the needs statement. There are several cases where educators can detect unsuccessful processes.

To determine whether needs statements work properly, educators have checked from two main perspectives; expression and content. **Adequacy of expression** is a perspective to check whether the problem situation and needs were extracted properly and whether functions are not included in the statements. *“The students often say that the problem is ‘the user wants to do something, but in reality, he/she does nothing.’ However, teachers probably think it’s two sides of the same coin, so there’s no difference.”* Table 1 shows the evaluation perspectives on the expression of needs statements.

Table 1. Concepts relevant to the evaluation of expression of needs statements

Category	Definition	Typical examples of failure
Adequacy of expression	Can it extract the problem situation and needs and include features?	The defined need is the flip side of the problem situation.

Table 2 shows the four perspectives for evaluation of content adequacy; **Consistency with the theme**, **Whether it is based on research**, **Feasibility of idea generation**, and **Consistency with the solution**. **Consistency with the theme** is a criterion to evaluate whether it aligns with the design theme, which indicates the issues to be addressed in the project. As one of the interviewees said, *“At the beginning of the project, I ask students, ‘Is there something wrong somewhere? Is what you are aiming for correct?’*

I think that is rather important.” Educators check that the perspective set by students matches the project scope.

Whether it is based on research is a perspective to evaluate whether it is based on facts obtained from surveys conducted to gather information from users and stakeholders. The evaluation was based on users’ experiences described in needs statements, whether they are difficult to imagine and mixed with students’ imagination and past experiences, leading to assumptions far from the facts. For instance, one explained: “(...) *when young people imagine the elderly, students’ understanding of the elderly is limited, so students tend to create new stories, mixing in stories about the elderly students have seen in TV dramas or newspapers.*” In this perspective, educators check whether these kinds of biases are included. After the problem definition, there is always the generation of ideas and the development of solutions. **Feasibility of idea generation** and **Consistency with solutions** were mentioned as perspectives to check the consistency with those ideas and solutions. **Feasibility of idea generation** was evaluated by inferring the ideas that could be generated in the problem setting and whether the statements would work appropriately as requirements. **Consistency with the solution** was the perspective of whether the problem the solution addresses is consistent with the defined problem.

Needs statements were checked to determine whether statements worked not only from the perspective of evaluating the logic as described above but also from evaluating the appropriateness of the statements.

Table 2. Concepts relevant to the evaluation of whether needs statements work properly

Concept	Definition	Typical examples of failure
Consistency with the theme	Is it consistent with the given design theme?	Out of the scope of the project
Whether it is based on research	Is it based on facts obtained from research?	Based on delusion or stereotype
Feasibility of ideation	Does it work properly as a requirement for idea generation?	Unstable as a starting point for idea generation
Consistency with the solution	Is there consistency between the problem that the solution addresses and the defined problem?	It does not indicate the problem that the solution solves

Other than confirming the above perspectives that assess if the needs statements support the design process, the educators had different views on assessing its quality. While educators stated that it is impossible to identify good cases based on the needs statement alone, educators described what perspectives have been used to identify typical failures. As a result, three perspectives existed, as shown in Table 3 below; **Newness**, **Clarity**, and **Efficacy**.

Table 3. Categories relevant to the evaluation to identify typical failures

Concept	Definition	Typical examples of failure
Newness	The problem defined is new, and there is an expression of surprise, discovery, and discomfort from the investigation. Something that is different from existing things and does not feel obvious.	What is commonly said Obvious before researching Normal/common sense / generalised
Clarity	The focus of the defined problem is narrow and concise. Not too complex or abstract.	Too much information, too abstract, too broad scope
Efficacy	The defined problem is essential to address and has several subjects. The problem is not too trivial or a particular problem with few subjects.	Too trivial, Not urgent, Not significant to tackle, Too small target

Novelty is a perspective that evaluates whether the defined problem is new and expresses surprise or discovery. Typical examples of failure were defining a problem for which there are many existing solutions or explaining a problem situation that can be understood without research. One educator said, “*I want it to express the kind of surprise that students first discovered when students interviewed.*” Another said educators would evaluate it as good if it expressed “(...) *something that has been overlooked or passed by unnoticed.*” On the other hand, many comments about needs statements were not novel, such as: “*Isn’t that something you knew before interviewing?*”

Clarity is a perspective that evaluates whether the defined problem is expressed accurately and concretely. Typical examples of failure were: too much information in the text, too abstract and unfocused, and too broad a scope of the defined situation. To quote from the interviews included, “*The target user needs to be clear.*” and “*the ideal state that the user is aiming for and how it should be achieved.*”

In terms of **Efficacy**, this perspective evaluates whether the defined problem is an important one to be addressed and whether there is a specific target audience. One educator asked in a project, “*How many people would be happy with that if designers met the defined needs?*” Another stated, “*Is it valuable to bridge the gap (between the current problem situation and the defined ideal situation)?*” Typical examples of failure include defining a trivial issue or targeting only a few people.

4 DISCUSSIONS

The analysis revealed the perspectives with which educators involved in design education evaluate needs statements. There were five perspectives to assess if the needs statement worked and three attitudes to consider its quality.

Educators evaluate logic and adequacy when evaluating whether the needs statements work correctly. Through content analysis, five perspectives were identified: **Adequacy of expression, Consistency with the theme, Whether it is based on research, Feasibility of ideation** and **Consistency with the solution**. These perspectives may have been used because students are new to the design approach and often generate needs statements that could not work as frames. Since framing is a specific skill in design activities, students need to gain its ability through projects. Therefore, these evaluation perspectives can effectively check whether the result of the framing could work or not.

While educators mentioned that the needs statements alone could not determine whether the process is good or bad, they describe the differences between good and bad needs statements. Regarding the evaluation perspective on quality, three perspectives were identified: **Newness, Clarity, and Efficacy**. The concepts generated in this research correspond to the indicators commonly used in the creativity evaluation of ideas proposed by Dean et al. (2006). In idea assessment, the rarity of the idea and whether the idea itself is surprising (originality) are evaluated, consistent with the concept obtained in this study, **Newness**. The **Clarity** defined in this study also corresponds to idea creativity evaluation metrics, and both evaluate the degree of elaborated and precise description of actions, outcomes, and situations. While Effectiveness evaluates whether a defined problem is essential to solving or has some number of stakeholders, the same evaluation perspectives are included in idea evaluation. Problem definition is known to proceed simultaneously with solution development (Dorst & Cross, 2001). Sometimes a solution is accompanied by a more detailed description of the problem or a reframing of the problem. Conversely, an improved definition of the problem can lead to the creation of a better idea. From this point of view, it is natural that the evaluation done on the concept relates to assessing the problem definition statement.

This study also has the following limitations. First, this study considers projects that adopted a design framework in which users’ needs are identified through empathic understandings of the users. Evaluation perspectives in the other types of projects are not considered, and the results from other types of projects could differ from this study. Second, as this study investigated perceptions of problem definition by teachers involved in design education, it is debatable whether these can be used as-is as evaluation criteria of the needs statement. In addition, the affiliations of the interviewees in this study make the results may depend on a specific context. We believe conducting further research with design educators from various universities is essential to generalise the findings. Third, problem definition and solution development co-evolve (Dorst & Cross, 2001). Educators also mentioned that assessing students’ processes based only on needs statements is impossible, and comprehensive evaluations are needed. As the degree of elaboration of problem definition changes along the project, the evaluation perspective may change accordingly. However, the present study does not include this aspect. We believe that additional interviews should be conducted to consider the co-evolution of solutions with the project’s progress.

While several studies of the problem definition exist, there is a lack of clear guidelines in design education for needs definition. Despite the above limitations, this study contributes to identifying evaluation perspectives on needs statements that had been tacit knowledge. This study could be the basis for supporting students’ activities such as framing, problem definition, and user understanding.

5 CONCLUSIONS

This study investigated the educators' evaluation perspectives for needs statements generated in design projects. Semi-structured interviews were conducted with nine educators involved in design projects with college students. Content analysis was used to identify educators' evaluation perspectives. The results revealed five evaluation perspectives for checking whether a problem definition statement works properly and three perspectives for evaluating the quality of the problem definition statement. Evaluation of whether the needs statement works was based on the following five perspectives; **Adequacy of expression**, **Consistency with the theme**, **Whether it is based on research**, **Feasibility of idea generation**, and **Consistency with the solution**. Evaluation of the quality of the needs statements was based on the following three perspectives; **Newness**, **Clarity** and **Efficacy**. The outcome was a structured perception of the educators involved in the design project in problem definition. The results are expected to help create clear instructional policies in educational settings and guide and support the process involved in problem definition.

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