


The EmotionProbe: an exploration of design students' emotions when designing

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Abstract

The emotional experiences significantly impact students' design processes. This research presents the EmotionProbe, a design probe tool for capturing design students' emotions while designing. The tool allows simple data collection, offering important insights into the students' design experiences, introducing the spectrum of emotions that design students go through, and showcasing various analysis approaches, allowing for a richer understanding of the design's emotional dimension. The research highlights the need for an emotional tool supporting students' emotional well-being while designing.

Keywords: design process, emotion experiences, design tools, design students

1. Introduction

Emotions often require us to pause and reflect before expressing or discussing what is related to them. At times, it can be challenging to identify or comprehend. It has a profound impact on our process (Norman, 2004). Expressing our emotions is not a simple task, as it is a multi-componential process that includes different affective, cognitive, motivational, expressive, and physiological components (James, 1948; Ekman, 1992; Scherer, 2005).

'What is an emotion?' remains a question of research. Emotion is challenging; once a satisfactory definition appears, a new theory emerges unexpectedly (Solomon, 1993). Research has been successful in distinguishing different features that influence emotion, including but not limited to: reasoning, cognitions, behaviours, states, and experiences, making it useful to guide the challenge of the definition (Lewis et al., 2010). Plutchik (1965) views emotion as adaptive responses in the individual life, pointing out that there are only a few primary emotions: joy, trust, fear, surprise, sadness, disgust, anger, and anticipation. Izard (2010) assures the essential role of emotion in directing individual actions, interactions, and behaviour development. On the other hand, design as a noun or a verb refers to the outcome or the process; it is the combined knowledge, experiences, and skills embedded in the process of planning, inventing, making, and doing (Archer, 1979; Lawson 2006). This process, in its iteration stages, consists of different decision-making and creative problems-solving in which emotion plays a greater role (Sas and Zhang, 2010b; Ho, 2015). However, no universally accepted standard method exists for measuring it (Scherer, 2005). In addition, limited research discusses the importance of emotions in the design process (Ho, 2010) and how to involve students' emotional experiences as part of the design education settings.

Through the exploratory study, this research introduces a methodological design probe tool that captures the students' emotional experience as they progress with their design project. Far from being merely a conventional addition, this design probe introduces a way to explore emotion by collecting simple data; it offers important insights into the students' design experiences and introduces the diverse spectrum of

emotions that design students go through within design educational settings. It is a tool expressly designed to accommodate the design processes employed by students during their design projects. The tool's capabilities of use were tested among design students from different cultural backgrounds, and its usability and reliability are presented through the variety of analysis approach results it can give.

2. Design and emotion

Glanville, (2006a) proposes that "*Design is self-conversation emphasises the significance of listening/being receptive*". Design primarily involves conceiving and realising new things (Cross, 1982) by combining the processes of planning and making (Archer, 1979). In these processes, various factors can be considered influential in advancing a designer's journey. Ho (2010) highlighted the emotionalised design in which the role of a designer's emotions in the design process is significantly important. Designers use their emotions as a compass that directs them to innovative solutions, apply empathically design approaches, and reshape the design processes (Cross, 1982; Crossley, 2003; Ho, 2014; Dybvik, 2022). Emotions have a powerful role in design and marketing (Norman, 2003).

Various research explored the role of emotion within the design process (Dorst and Cross, 2001; Forlizzi et al., 2003; Desmet and Hekkert, 2009; Ho, 2014). The design processes involve iteration, circularity, and a willingness to navigate the unknown, involving trial-and-error phases of rejecting and restarting again (Glanville, 2009). Hence, this process encompasses both external and internal factors influenced by emotion which, in turn, impacts the design processes (Ho and Chau, 2016). Furthermore, research on how positive emotions impact cognitive processes indicates the remarkable effect on information processing, communication, decision-making, sorting, and creative design problem-solving (Park, 2004). Moreover, research by Isen (1991) has revealed that positive emotion enhances cognitive flexibility and the ability to create relations. Positive emotion opens a bigger horizon of attention, cognition, and actions (Fredrickson, 1998). Emotions are the fuel of being engaged, motivated, and excited during the design process (Sas and Zhang, 2010b). Desmet et al. (2023) introduced the 'micro emotions' to guide design improvements by enhancing positive experiences and inspiring new design innovations.

2.1. Emotion measuring

Many research studies have been undertaken to measure emotions, particularly in psychology and sociology (Desmet, 2003). However, measuring emotions comprehensively is challenging due to its multifaceted nature. It suggested that to measure emotions fully, research should include all changes that happened within the appraisal processes (Scherer, 2005). Yet, the choice of a method for conducting emotional research depends on the specific goal of the study. Methods such as questionnaires and facial, physiological, and behavioural expressions are usually used but are influenced by biases or resection of the research environment (Meiselman, 2015). Hence, the compound emotions nature creates a diverse measurement tools. These tools can be structured within different categories of measuring, including emotional expressions (pattern of facial and vocal expressions), physiological reactions, behavioural reactions (motivational changes), and subjective feeling states (Demset, 2002; Scherer, 2005). Nevertheless, conducting such an extensive measurement of emotions is not easy and it is unlikely to become a standard way in the foreseeable future (Demset, 2002; Scherer, 2005). Therefore, research in this area tends to concentrate on individual components that align with specific research requirements and objectives. No method exists to measure the subjective experience during an emotional episode (Scherer, 2005). Demset's (2003) review of the literature on the emotions measuring instrument identified two approaches:

1. **Non-verbal instrument**, focusing on expressive (e.g., facial and vocal cues) and physiological components (e.g., heart rate). However, this approach is limited to the basic emotion approach (Scherer, 2005; Demset, 2003).
2. **Verbal-instrument**, focusing on the subjective feeling components in which a mix of emotion and a scale can assess the result. Within this tool, there are two response formats: a free response format, allowing participants to express their emotions freely, and a fixed response format,

providing participants with a list of emotions to select from (Scherer, 2005). However, this approach may face cross-cultural challenges (Demset, 2003).

Thus, while the field of emotion research has seen rapid and substantial progress, measurement tools, particularly in the context of design, have lagged behind (Norman, 2003). Consequently, there is a need for a tool that draws from the existing literature and can assess students, emotions during a design project.

2.2. Design probe as a tool

Design is evolving rapidly, encompassing various experiences individuals encounter in their daily lives. Therefore, researchers within the design community were motivated to create tools to enhance their understanding of these intangible experiences (Gaver et al., 1999; Hemmings et al., 2002). Probes are toolkits explicitly designed to gather information from the user's own reflection, including their experiences, feelings, attitudes, and actions within a specific context and based on the research purposes (Mattelmäki 2005). It is a self-documentation tool that helps break the boundaries between designer, researcher, and people (Gaver et al. 1999). Mattelmäki (2005) identified four types of probes: cultural probes, informational probes, technological probes, and emphatical probes; which all of them are design-oriented and exploratory in nature; reflecting values, needs, and social and emotional engagement (Mattelmäki, 2005; Mattelmäki, 2006).

Designer employs the design probe as a tool to creatively gather data with minimal disturbance (Rodgers and Milton, 2013) and explore new opportunities (Mattelmäki, 2006). This method is viewed as a valuable self-documentation tool. Firstly, it aids in gathering data from various real-life scenarios, enhancing both credibility and reliability (DeLongis et al., 1992). Additionally, it reduces researcher bias and provides users with a greater opportunity to convey more informative content (Carter and Mancoff, 2005). This approach enhances transparency and the integrity of the collected data by capturing context-related experiences in real-time (DeLongis et al. 1992, Brown et al. 2000). A probe is introduced in a mean of a designed kit that includes different tools, instruments, and objects designed to fulfil a task, assignment, activity based on the research aims and objectives (Mattelmäki, 2006). Thus, inspirational responses can be generated by gathering clues from people's lives and thoughts (Gaver et al., 1999). For this reason, the probe is considered a strong tool that enriches the designers' inspiration, collects valuable data from the users themselves, and creates a strong connection between the users and the designers (Mattelmäki 2005). Conversely, these methods encounter weaknesses; considerably, the data could be excessively vague and scattered, featuring an overly expansive scope that renders it unsuitable for making specific design decisions (Mattelmäki, 2006). In addition, probe-based context evaluation lacks control over participant responses, potentially resulting in few or no returned probes and costly investments with minimal results. Success depends on the initial relationship between the designer and participants, and designers can only access what participants allow without means to verify response validity (Townsend and Patsarika, 2022). In addition, Probes are like a way to ask questions; when people use them, their answers are shaped by their own understanding. Designers later make sense of these responses on their own, in which instruction didn't consider factors like culture, context, or communication (Townsend and Patsarika, 2022).

A combination of methods is necessary and not only rely on observations (Crossley, 2003). Therefore, the research presents the *EmotionProbe* as a simple means to gather emotions during the design process. The probe provides a standardised list of emotions and an intensity scale to collect qualitative and quantitative information on the student's experiences while designing. Participants reported their responses by selecting one emotion that corresponded with their felt emotion(s) and experiencing it by completing sentences related to a specific stage of the design process.

3. Methodology

3.1. The EmotionProbe design tool

This research introduces the *EmotionProbe* (Figure 1), structured around a design process comprising six stages and distributed among students across two reporting sessions. The design process by Milton

and Rodgers (2013) was used, consisting of six stages: design brief and specification, research opportunity (identification), concept design, design development, detail design, and production. This framework allows iteration at each stage, its detailed stages encountering clarity for deeper exploring during each stage, and in addition to the six stages, it incorporates seven methods of looking, learning, asking, prototyping, testing, evaluating, and communicating, which can be utilised during the process. In actuality, the design process rarely follows a linear path. It is common to uncover novel information at every stage that encourages revisiting a previous stage. Referring to that discussion of related concepts, this research created 27 sentences to be completed based on this framework. It emphasised the importance of the emotional experiences associated with designing rather than the outcome of the given design project.

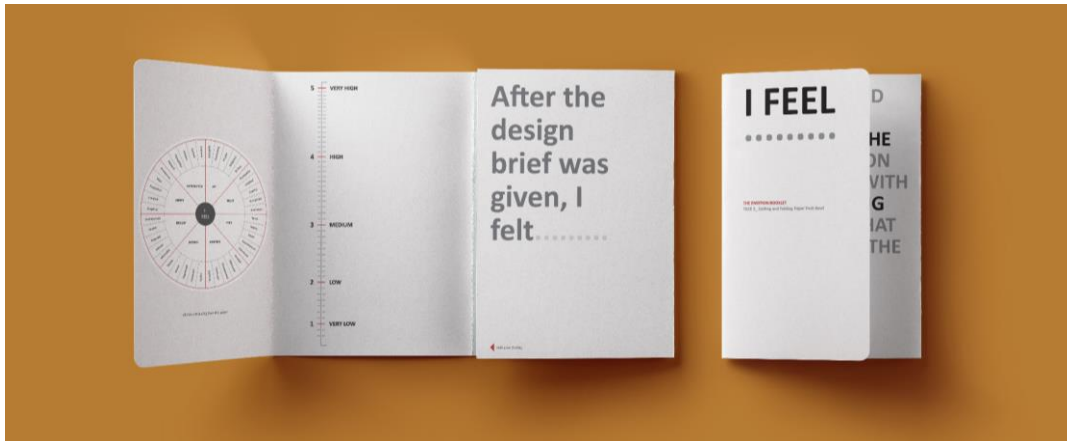


Figure 1. EmotionProbe design tool

3.2. The probe components

The *EmotionProbe* is a design probe tool designed specifically to collect related research data, qualitative data relating to the emotional states of the design students, and quantitative data highlighting the intensity of these states. The 29 undergraduate design students with at least one year of design experience took part in completing it as part of their regular degree programme. The probe introduced three main elements (Figure 2). Together, these elements offer both qualitative insights and quantitative measurements, enabling a deeper understanding of the student's emotional states:

3. The emotion wheel.
4. The sentence to complete.
5. The intensity scale.



Figure 2. Details of the inside pages

3.2.1. The emotion wheel

The emotion wheel is considered one of the effective tools used to utilise emotion in psychological research (Plutchik, 1982). Two emotion wheel models were used to create the final wheel for the probe. Firstly, Plutchik's (1982) 'Wheel of Emotion' offers a three-dimensional model consisting of both basic-complex categories and dimensional theories covering the emotional dyads concept (Plutchik, 1991; Plutchik, 2001). Secondly, Willcox's (1982) 'Feeling Wheel' developed based on the Plutchik wheel, aiming to aid individuals in learning about their emotions by identifying, generating, and expressing changes in emotion. The developed *EmotionProbe* wheel consists of 48 emotions including eight distinct emotions - joy, trust, anticipation, surprise, sadness, disgust, anger, and fear and other emotions derived from these categories. (Figure 3).

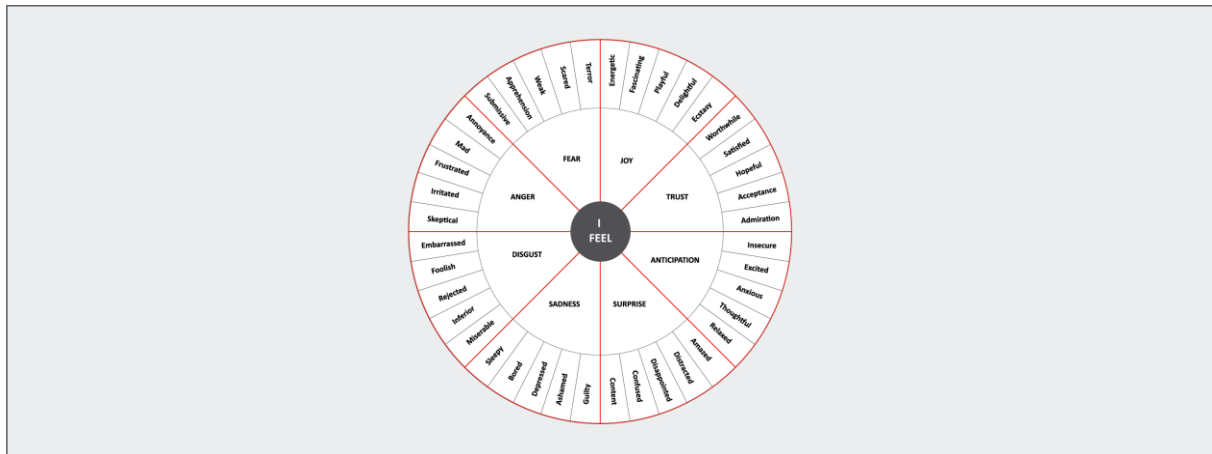


Figure 3. The emotion wheel used in the EmotionProbe

3.2.2. The sentence to complete (SCT)

Qualitative analysis was utilised in this research to understand emotional states, and the sentences for the probe were created using the Sentence Completion Test method (SCT) (Figure 4). Responses based on this method can provide insights into the emotional quality, intensity, passivity, and symbolism (Sacks and Levy, 1950). This method has been beneficial in investigating mental and intellectual abilities, as shown in Ebbinghaus's research on mental abilities in the 1970s (Holsopple and Miale, 1954). Watson (1978) reviewed the usage of this method during that period and highlighted two other studies that relied on this approach to study emotional responses and assess personality. Nowadays, (SCT) method is employed in various fields to evaluate and enhance personal expression. (SCT research dataset: <https://doi.org/10.15129/462eb255-86dd-4933-ab7b-e97857ff50c3>)

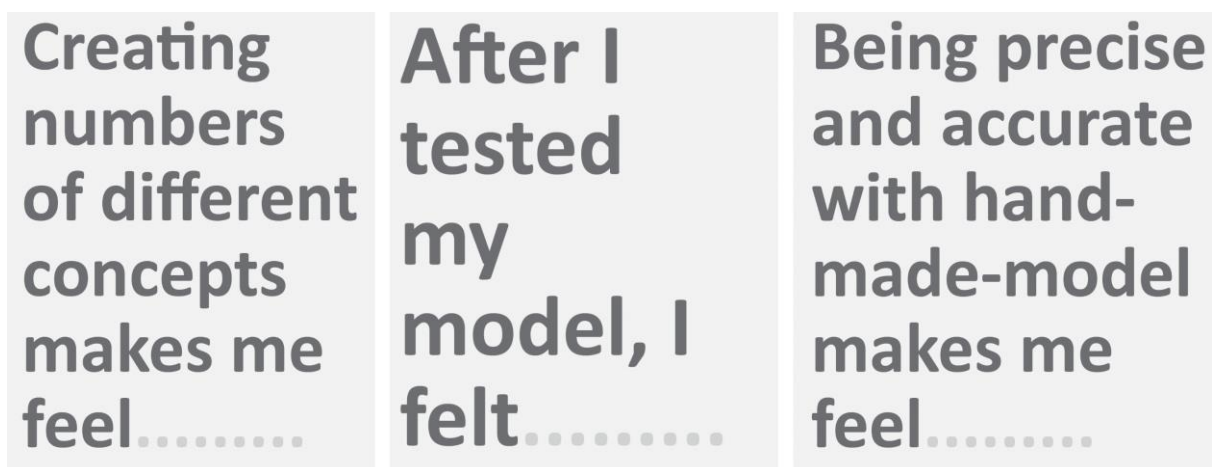


Figure 4. SCT example

3.2.3. The intensity scale

According to Taherdoost (2019), the selection of a response scale is influenced by the research goals, the nature of the questions posed, and the characteristics of the population under study. This paper employed a Likert scale to measure intensity, with students rating their experiences on a numerical scale of 1 to 5. A rating of 1 indicates very low intensity, while a rating of 5 denotes very high intensity. Despite the focus of this study on the emotional spectrum, the scale plays an important role in identifying the most intense phases of the design student's journey. The original five-point scale was utilised to promote faster and easier data collection, thereby ensuring symmetry and balance in the scale (Figure 5).

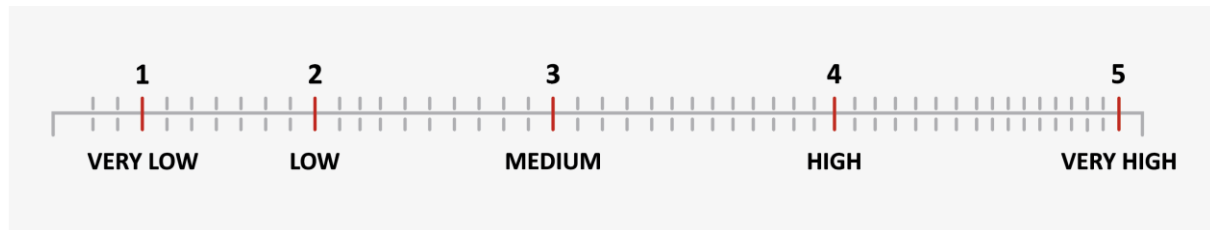


Figure 5. Likert scale

3.3. Participants

The exploratory study includes 29 undergraduate design students with a minimum of one year experience in design from two universities, the German Jordanian University at the Department of Design and Visual Communication - Jordan and the University of Strathclyde at the Department of Design, Manufacturing, and Management Engineering - Scotland studying design. 14 from Scotland were aged between 18-21. Among them, 7 identified as female, and 7 identified as male. 15 from Jordan were aged between 19-23. Among them, 8 identified as female, and 7 identified as male.

4. Analysis approach result

A considerable aspect of this probe is its ability to showcase various approaches to analysis, providing insight for researchers in the field of design to dig deeper into the emotional dimension of the design process. The variety analysis outcomes can aid design educators in uncovering more information and intricate aspects of how emotions are manifested and interact with the design process, allowing for a richer understanding of this critical aspect of a design project. It helps design researchers explore diverse perspectives, thereby contributing to a more comprehensive examination of the emotional elements while designing. The analysis approach has the capacity, including but not limited to unveiling how emotions manifest themselves within the processes (Figure 6) by highlighting each emotion behaviour during the design process compared to other emotions, focusing on each stage and uncovering the most felt emotion (Figure 7), capturing the experiences of individual students, and exploring students' journeys in light of their unique personality traits factor (Figure 8). Additionally, it enables exploring the differences and similarities among students from diverse cultural and educational backgrounds. It also opens the way to focus on a certain emotion and study it as a significant within the processes.

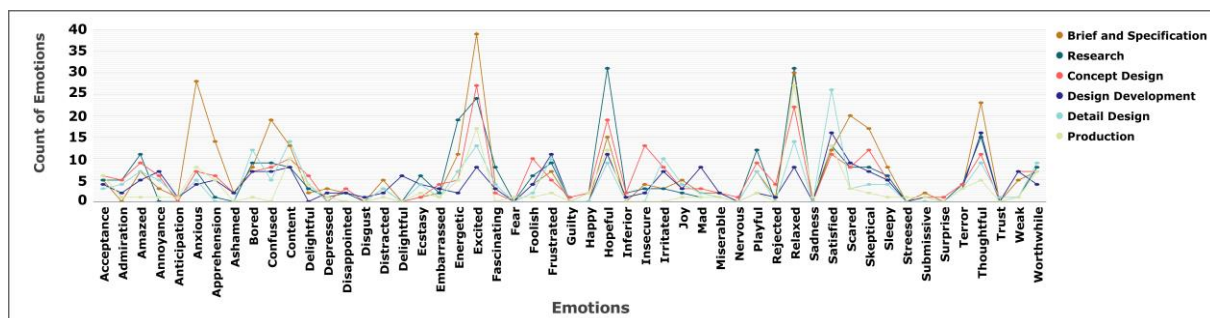


Figure 6. Emotional experiences in the design process: a comprehensive approach

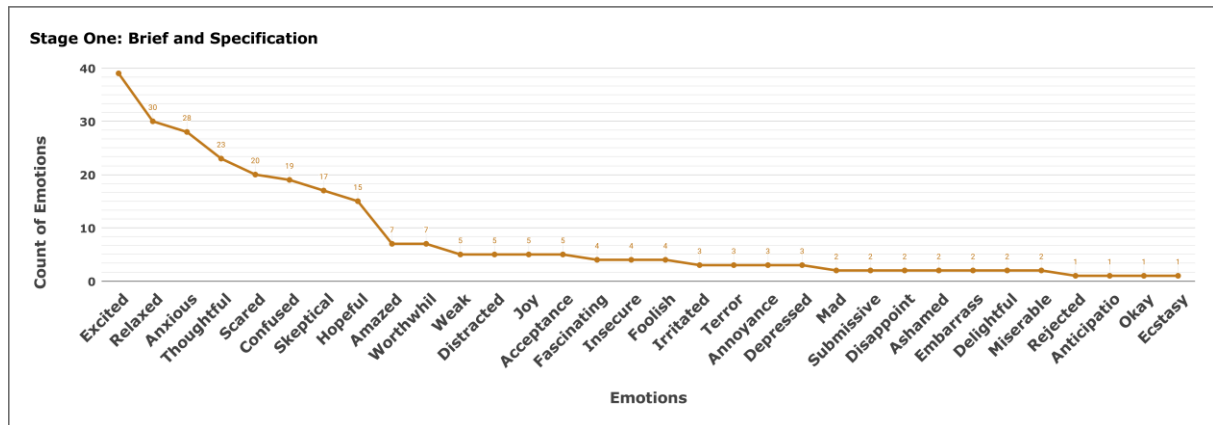


Figure 7. Emotional representation at a stage of the design process

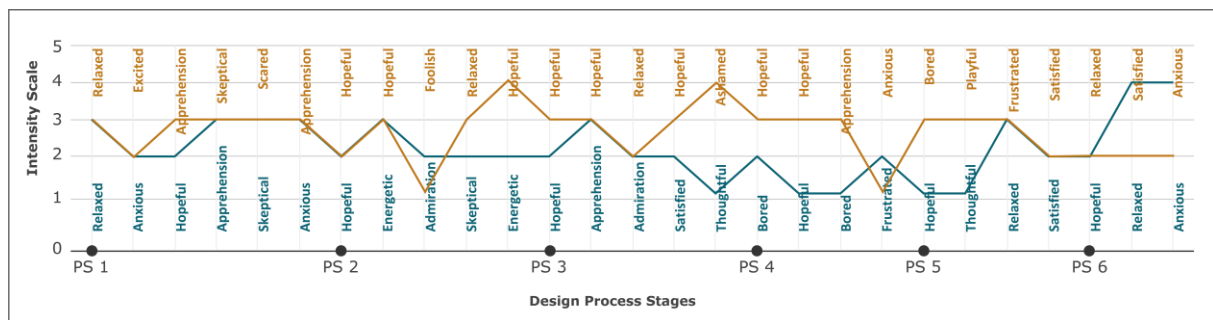


Figure 8. Individual student experience while designing

According to the results obtained from one of the analysis approaches applied to the collected data, students in both sessions recorded 47 out of 48 emotions from the provided list. Interestingly, both student groups didn't record the emotion of **anger** during the whole process. This indicates that the probe identifies emotions closely linked to design processes compared to other emotions, providing insights into the emotional dynamics unique to design activities.

5. Discussion

This research presents a new verbal-self-reporting design probe tool, the *EmotionProbe*, for capturing design students' emotional experiences while designing. We aimed to present how this probe would explore students' emotional experiences from different backgrounds. The research examines the useability and the reliability of the created probe, including the *EmotionProbe* ability to employ a diverse range of data analysis approaches to offer valuable insights and explore the spectrum of emotions students experience during the design process. To achieve this, the initial step involved creating a design project for application among diverse design students from different cultural and educational backgrounds, aligning with the probe mission. Hence, the study included participants from two different countries. In total, 29 students from Jordan and Scotland participated. The design students were asked to design and prototype a paper/card fruit bowl only using cutting and folding manufacturing techniques and processes. This task was aligned with two elective department courses under a product design theme. The task duration spans on four lectures, and the probe was distributed based on two sessions during the design process (Table 1).

Table 1. Sessions, processes, and activities

Sessions	Design Process stages	Activities
Session One	Design project brief introduction and research	Introducing the task to students, the students start researching and drawing concept and sketching.
Session Two	Design concepts and design details	Students working on prototyping, feedback, and filling the <i>EmotionProbe</i> -first session reporting
Session Three	Design development	Developing the final concept, feedback in case needed
Session Four	Production	Submitting the final design of the fruit bowl, and filling the <i>EmotionProbe</i> -second session reporting

The usability of the probe was tested within two different sessions. The observation showed that the probe was easily utilised by students, requiring a short amount of time to complete, and it allowed students to express their emotional aspects within their project. This probe was designed to provide an equal approach for students in its use. Hence, a printed copy with consistent quality and characteristics was employed to prevent variations in how information is perceived through digital tools and create an engagement while working with it. Regarding reliability, students reported their own emotions without any interruption from the researcher or the mentors during the session. This probe captures the emotions experienced by students in their current situation. It enables a representation of the emotions as they occur in real-time, providing instant responses from students during their design activities. The need for such a tool comes from the important effect of emotion on the design process and the lack of research investigation about the influence of emotions on the design processes and how designers can understand the emotional impact on their processes (Ho, 2015). The probe experiment showed multilabel approaches for analysing the emotional experiences. Also, it aided not only students but educators in revealing the emotions behind the students' design processes. The strength of the *EmotionProbe* is that it explores emotions in each stage of the process and can be used cross-culturally, including mixed emotional expressions within one stage. This probe doesn't need any expensive equipment or technical skills. It's easy to use and navigates the emotion within the wheel; students and mentors can easily apply it and gain insight into the experiences. However, a potential limitation when using this probe is the constraint imposed by the predefined list of emotions, which may not encompass the full spectrum of emotions students can experience during the design process. This limitation implies that some less commonly recognised emotions might not be captured or expressed, which appeared within some students' responses, including emotions such as **happiness, stress, and nervousness**. Therefore, Researchers must recognize constraints, consider addressing unlisted emotions, and enhance those relevant to the educational spectrum.

6. Conclusion

The *EmotionProbe* developed in this research aims not only to introduce a new tool and identify emotions during design processes but also to explore the reasons behind these emotions at specific stages, enabling further investigation. Emotions profoundly influence the entire process and enhance the education experiences that support students' emotional well-being (Pekrun & Stephens, 2010). This probe serves as a bridge between students and their emotions as well as between students and design mentors. Addressing students' emotions within educational settings is often overlooked, but the *EmotionProbe* offers a way to incorporate the emotional dimension without diminishing students' self-esteem, making emotional experiences tangible and accessible. This research is part of broader research efforts to understand students' emotional experiences better. Future work will involve several development phases to improve the probe's versatility and utility. Experimentation will target areas where the probe may have shortcomings in design education to identify pain points and effects for design educational purposes.

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