

INFLUENCES OF PEER CRITIQUE, COLLABORATION AND ITERATION ON TEAM DYNAMICS AND HUMAN-CENTERED DESIGN OUTCOMES IN PRODUCT DESIGN STUDIOS

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ABSTRACT

Studio-based learning is the foundation of product design education and includes practices like peer collaboration, iterative making processes, tutor critiques and peer-to-peer critique sessions. However, the contributions of peer critique sessions to students' teamwork dynamics and their application of human-centred design (HCD) principles remain under-examined. This study examines how this core studio practice shapes students' ability to work effectively in teams and apply HCD principles in their design decisions. Adopting a mixed-method approach across multiple product design studio courses, the research integrates pre- and post-survey data, structured observations of peer critique sessions, coded transcripts of student-to-student feedback, and longitudinal analysis of project artefacts. Quantitative measures assess teamwork quality, psychological safety, and HCD application, while qualitative data analyses reveal how peer discourse and shared problem framing influence design reasoning. Preliminary hypothesis proposes that well-structured peer critiques-especially those emphasising user needs-enhance collaborative cohesion, deepen empathic understanding, and improve HCD outcomes across iteration cycles. By illuminating how peer-driven critique and collaborative studio practices most effectively foster empathy-driven decision making and cohesive team dynamics, the results of this study provide evidence-based strategies for product design educators seeking to strengthen reflective, empathetic, and team-oriented product design education.

Keywords: Peer critiques, collaborative learning, iterative learning, Human-Centred Design, design pedagogy

1 INTRODUCTION

Hands-on learning has traditionally proven to be very effective method of teaching where students learn by thinking, doing, and working with others [1,2,3] and it is especially more so in the case of product design education. Product Design has always employed the studio-based learning as studio spaces let students combine hand-on technical knowledge with creative exploration while getting feedback on their designs. Students learn various aspects of design through iterative making, reflective dialogue, and critique, which helps them develop problem solving skills and design thinking skills [1,3,5]. The critique is a very important aspect of product design education as it is a tool that allows students to share ideas, discuss and evaluate each other's work thereby learning through reflection as opposed to just instruction [1,7].

Traditionally, critique sessions are mostly led by the tutor, where they are positioned as experts imparting knowledge and students on the receiving end [1,8]. This arrangement gives valuable guidance and helps students learn effectively, but studies show it can also reinforce concepts of hierarchy, heighten anxiety, and inhibit self-expression and opportunities to learn from each other [8,9]. Critique sessions are significant in how they have an effect on students' confidence, willingness to participate and take creative risks [9]. Alternatively, peer critique transfers some evaluative authority to the students. This enables them to share their ideas more freely and opens up avenues for collective discussions [7,10].

Product design programmes, nowadays, stress upon the importance of teamwork, interdisciplinary collaboration and user-centred innovation. In addition to having a deep understanding of users' needs, design graduates are expected to work effectively with others [3,5,6,11]. But students often are unable to

integrate their learnings about their users beyond the initial stages of design even though human-centred design (HCD) provides applicable frameworks. Despite peer critiques being used in product design education, its role in encouraging teamwork, fostering psychological safety and incorporating HCD remains under-examined [4,7,10].

This paper addresses this gap by examining how peer critique can become an effective teaching tool by studying how it affects the above factors and thereby adds empirical data to discussions about product design education [3,11].

2 REVIEWS OF LITERATURE

Design education is at a critical juncture. With the advent of new technology and changes in the way we interact with it, design education needs to also keep with all these changes. This literature review reflects on the changing trends and shifts in contemporary design pedagogy and charts its trajectory into the future.

2.1 Studio-based Learning in Product Design Education

Studio-based learning is based upon experiential and constructivist theories that emphasise that knowledge is shaped through action, reflection and engaging with others. Schon's reflective model highlights the significance of reflection-in-action and reflection-on-action where learning comes through problem finding and solution finding, and the analysis thereof, while Kolb's experiential learning model posits learning through a continuous cycle of experience, reflection, conceptualisation and action [1,2]. The design studio provides the environment for nurturing professional identity and developing sound design judgement [3].

2.2 Critique and Peer Learning

Critique in design education has traditionally been a tutor-led activity. Recent research has shed light on students experiencing emotional stress due to the associated power dynamics [8,9]. Peer critique is emerging as a pedagogical mechanism that reduces hesitation thereby fostering active participation and encouraging students to be more vocal, clearer design thinking and more accepting of alternate views, and better shared understanding among them [7,10].

2.3 Teamwork and Psychological Safety

Projects are a common aspect in product design curricula and most projects have some assignments, if not all, that are group projects. Group projects help students learn to work together towards a common goal and face critique with more confidence as they explain their contribution towards the team effort. As such psychological safety becomes a critical factor to ensure productive collaboration [4].

2.4 Human-Centred Design (HCD) in Education

HCD is a problem-solving approach that places the user's needs and experiences at the centre of the design process its incorporation in design curricula is widespread. However, students find it difficult to implement HCD principles beyond the initial stages of the design process [5,6]. Peer critique sessions may become an important asset as it allows open discussion on user's perspective and hence help in shaping better user-centred design decisions.

3 RESEARCH METHODOLOGY

A mixed method data collection and analysis method was employed for this study in which data was collected in two phases. In phase one, publicly available course data was collected from universities offering product design programme. Course content and syllabi were obtained from institutional websites and analysed to identify open discussions as mode of teaching, along with commonly covered topics. Qualitative content analysis was employed to draw out prevalence of peer learning inclusion. In phase two, detailed semi-structured interviews were carried out with product design students to understand how their design studios were conducted. The participants selected were a homogenous group belonging to different institutes and selected through snowball sampling. Out of the 78 students approached, 56 agreed to participate in the interview, comprising of 25 males and 31 females. Participants were asked for their consent before and most of them were interviewed in person. The interviews were focussed on studio courses in product design that included individual and group assignments, and explored topics such as critique and peer learning, teamwork, psychological safety and

importance of HCD in design education. To better assess these factors, pre- and post-course surveys were administered and all items were measured on a 5-point Likert scale. Structured observations of peer critique sessions were also conducted looking at participation patterns and nature of feedback. The analysis also examined how feedback from critique sessions influenced the final output.

4 FINDINGS

Peer learning or peer critiques have been in use for some time now but in recent years we see an emergence and also a widespread acceptance by universities and schools as a formal teaching tool. Data collected in phase one, on universities, indicate the importance of formal and informal peer interactions in studio environments. RMIT University in Australia introduced a structured peer-learning model within its core Art and Design programmes relying on student-led peer reviews to promote learning. In fact, RMIT has developed and introduced a range of tools to support access and structure in peer learning [12]. Aalto University in Finland encourages students from different disciplines to collaborate on projects and facilitate feedback from peers and industry professionals. Aalto has implemented this model across all its campuses underscoring the educational value in creating sensitive, rounded designers [13]. Observational analysis revealed that peer critique sessions resulted in joint problem-solving rather than judgement. This created a shared sense of ownership of their design solutions.

4.1 Teamwork and Psychological Safety

To examine students' perception of teamwork and co-operation, they were asked to fill out a questionnaire with a few statements that focussed on key teamwork constructs like collaboration, coordination, shared responsibility and communication. Table 1 below lists the statements.

Table 1. Teamwork Quality Statements

No.	Statement
T1	Team members communicated effectively with each other during the design process
T2	Responsibilities within my team were clearly understood and distributed
T3	My team was able to resolve disagreements constructively
T4	Team members were committed to shared project goals
T5	Collaboration within my team improved the quality of our designs
T6	I felt accountable to my team for my contributions

Figure 1 shows a comparative analysis of mean calculations based on all the responses received from participants from both the pre- and post-course surveys. Improvements were seen across all six testing parameters as evidenced by the visible increase in mean values. Notably, visible increase was seen in T3, T4 and T5 suggesting that students reported improvement particularly in collaborative contribution and shared responsibility in the team.

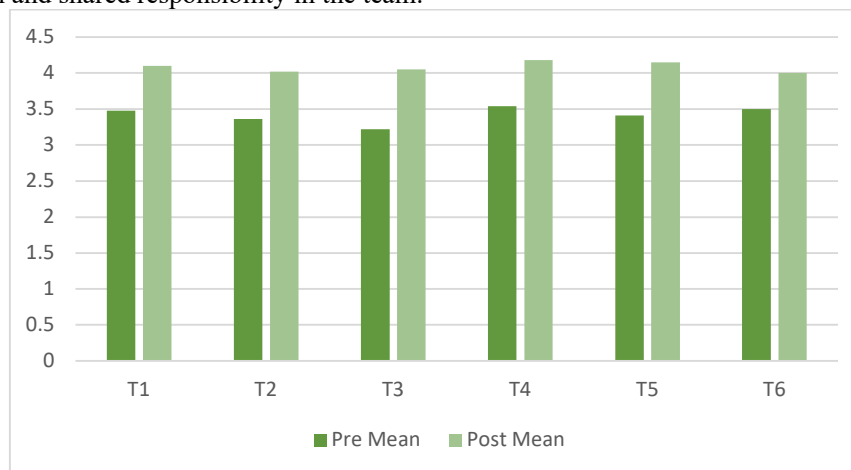


Figure 1. Teamwork Quality Index

The questionnaire included statements that focussed on key psychological safety constructs like openness, trust during critiques and interpersonal risk-taking. Table 2 below lists the statements.

Table 2. Psychological Safety Statements

No.	Statement
P1	I felt comfortable expressing my ideas during peer critique sessions
P2	I could ask questions or seek clarification without fear of negative judgement
P3	Mistakes were treated as learning opportunities in my team
P4	I felt safe giving honest feedback to my peers
P5	Different opinions were respected during critique discussions
P6	Peer critique sessions encouraged open and respectful dialogue

Figure 2 shows a comparative analysis of mean calculations based on all the responses received from participants from both the pre- and post-course surveys. Improvements were seen across all six testing parameters again, as evidenced by the visible increase in mean values. Notably visible increase was seen in P1, P4 and P6 suggesting that students reported reduced hesitation in expressing ideas, giving feedback and engaging in discussions during peer critique sessions.

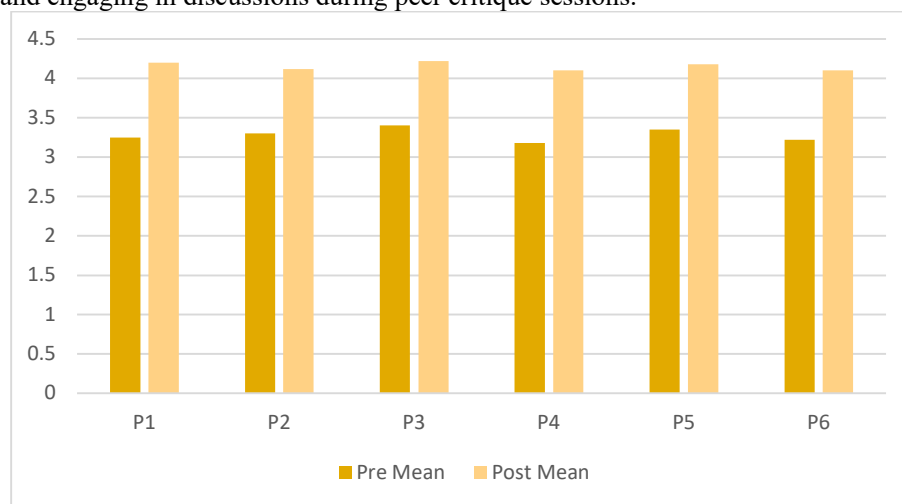


Figure 2. Psychological Safety Index

According to the survey results, at the end of the course, students reported improvement in interpersonal dynamics leading to improved teamwork and psychological safety. Observational data indicate that peer critique sessions improved active participation that tutor-led sessions.

4.2 Impact on HCD Application

To examine students' perception of HCD and its integration into their designs, the questionnaire included a few statements that focussed on key HCD competence constructs like empathising with the user and understanding user needs, incorporating user insights into design process. Table 3 below lists the statements.

Table 3. HCD Application Statements

No.	Statement
H1	I am confident in identifying and articulating user needs
H2	User research meaningfully informed my design decisions
H3	I considered users' emotional and experiential needs during design development
H4	Peer feedback helped me better understand the user perspective
H5	I can justify my design decisions based on user insights

H6	My ability to apply HCD principles improved during this course
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Figure 3 shows a comparative analysis of mean calculations based on all the responses received from participants from both the pre- and post-course surveys. Improvements were seen across all six testing parameters as evidenced by the visible increase in mean values. Notably, visible increase was seen in H2, H4 and H5 suggesting that students reported improvement particularly in meaningful translation of user awareness and insights into constructive design decisions.

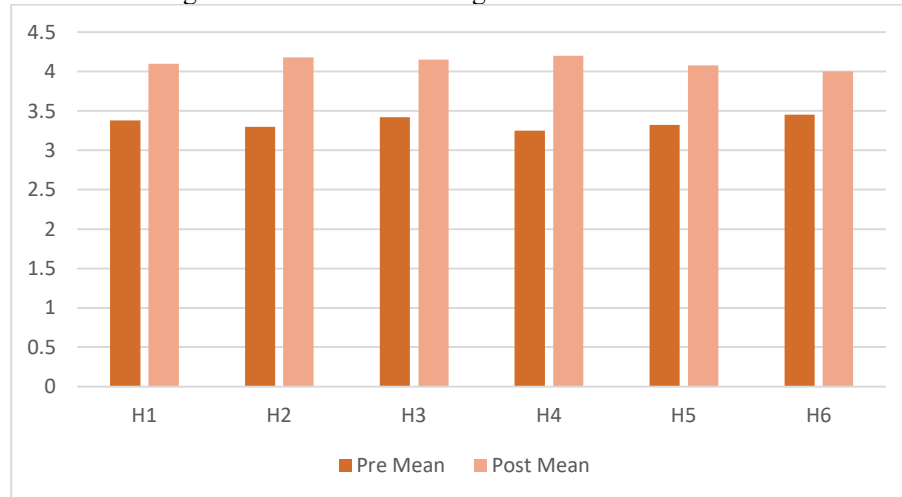


Figure 3. HCD Application Index

Table 4. Mapping of survey questionnaire items to analysed outcomes and findings reported in the study

Questionnaire Item	Construct Measured	Reported Outcome
Teamwork Quality	Team communication and shared goals	Improved teamwork quality
	Role clarity and accountability	Increased team coordination
	Conflict resolution	Constructive collaboration
Psychological Safety	Comfort expressing ideas and giving feedback	Increased psychological safety
	Respect for differing opinions	Open dialogue during critiques
	Learning from mistakes	Reflective learning <u>behaviour</u>
HCD Competence	Articulation of user needs	Stronger user justification
	Use of user research	Deeper HCD integration
	Empathy and experiential reasoning	Empathy-driven design decisions

5 DISCUSSION AND IMPLICATIONS

The results generated from the analysis of university course conduct and available syllabi and that resulted from the interviews of product design students show significant benefits behind incorporating peer critique as not only a mode of evaluation but also as a key pedagogical mechanism that plays a pivotal role in helping students build understanding, distribute evaluative responsibility and integrate user insights into all stages of the design process while aligning with constructivist learning theories [1,3,7]. Psychological safety plays a very important part as an enabler for a productive peer critique session. Students participate more willingly and actively when they are facing their own peers in a more informal environment. When they know that their ideas will not be judged, students are able to share their ideas more freely and be more open to constructive criticism and feedback. HCD principles were

also seen to be implemented more frequently by students as a result of employing peer critique sessions. They started to look at user needs and insights more closely as a result and incorporated in their design discussions. The findings suggest that peer critique should be seen, not as an informal studio activity, but as a critical part of design teaching. The implications it holds for design educators are:

- Structuring peer critique through prompts to address user needs.
 - Assigning rotating peer roles to widen perspectives and deepen sensitisation.
 - Requiring reports illustrating critique feedback to design changes.
 - Aligning assessment rubrics with collaborative and human-centred learning outcomes.
- These strategies help make the product design curriculum more robust and help educators mould their students into empathetic designers with technical competence and collaborative skills.

6 CONCLUSIONS

The integration of peer learning mechanisms is necessary in product design education to build effective teamwork, promote psychological safety and ensure meaningful application of HCD principles in design process. Incorporating peer critique sessions mindfully, results in protected psychological safety, and places evaluative authority with students thereby encouraging honest conversations about design and sensitisation about user insights. This also aids students to respond constructively to critique and helps them in openly participating in the design process. For educators, peer critique sessions provide a forum for open discussion and identifying and honing skillsets. It helps students by exposing and preparing them to the rigors of working in a professional, collaborative environment thereby underscoring the importance of peer critique as more than just an assessment tool. This study provides empirical evidence linking everyday studio interactions to social and cognitive aspects of learning. While this study focuses on undergraduate product design education, its learnings might be applicable to disciplinary variations and other applications in the future. By intentionally integrating peer critique into studio culture, product design education can better equip students to handle the social and professional dynamics in their design careers.

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