Fostering Interdisciplinary Design Innovation: A Social Identity-Driven Intervention Model (SIDIM)

Yang Susu[*1]

[1]School of Humanities and Law (School of Foreign Languages),Zhejiang AF University,Hangzhou,China

Abstract: In an era of rapid digital transformation, interdisciplinary collaboration has become a cornerstone of design innovation. However, effective collaboration within diverse teams is often hindered by communication barriers, disciplinary silos, and the lack of a shared group identity. This paper introduces the Social Identity-Driven Intervention Model (SIDIM), a framework designed to enhance interdisciplinary design innovation by cultivating a superordinate design group identity. SIDIM integrates social identity theory with digital collaboration tools, including virtual reality (VR) and AI-assisted design platforms. A 12-week quasi-experimental study involving 62 interdisciplinary teams (N = 310) evaluates the model. The experimental group receiving SIDIM showed significant improvements across five dimensions: Design Group Identification, Collective Innovation Efficacy, Innovation Norms and Goals, Challenge Appraisal, and Innovation Response. The intervention also produced gains in collaboration efficiency, innovation quality, business value potential, and team satisfaction. The findings suggest that identity-focused interventions, supported by immersive and intelligent technologies, can help interdisciplinary teams overcome silos and unlock collective creative potential.

Keywords: interdisciplinary collaboration; design innovation; social identity theory; virtual reality; AI-assisted design; team innovation

1 Introduction

The contemporary innovation landscape is marked by complex problems that require the integration of knowledge from multiple disciplines [22, 26]. From sustainable technologies to human-centered artificial intelligence, many design challenges cannot be solved inside a single domain. Interdisciplinary collaboration has therefore shifted from a peripheral advantage to a central requirement for organizations seeking breakthrough innovation [8, 18]. Design is especially affected by this shift because modern projects combine engineering, computer science, business strategy, psychology, and social science in order to create holistic solutions [4].

Despite this promise, interdisciplinary collaboration is often constrained by practical and psychological barriers. Teams with different professional backgrounds may struggle with communication, conflicting methods, and divergent mental models [7, 9]. These difficulties are intensified when members primarily identify with their own disciplines, creating "us-versus-them" dynamics that reduce trust and knowledge sharing [1, 15]. Social Identity Theory suggests that a shared superordinate identity can reduce subgroup boundaries and promote cooperative behavior [27]. In interdisciplinary design, this implies that cultivating a common "design team" identity may be a powerful way to strengthen innovation.

This paper introduces SIDIM, a Social Identity-Driven Intervention Model that operationalizes social identity principles for technology-mediated design work. SIDIM combines identity-building workshops, guided team rituals, VR co-creation, and AI-assisted design tools. The model proposes that these interventions influence five constructs: Design Group Identification, Collective Innovation Efficacy, Innovation Norms and Goals, Challenge Appraisal, and Innovation Response. We evaluate SIDIM through a 12-week quasi-experimental study with 62 interdisciplinary R&D teams.

2 Related Work

2.1 Interdisciplinary Collaboration

Interdisciplinary collaboration is widely recognized as a driver of innovation and complex problem solving [12, 25]. Diverse teams can generate more robust solutions because members contribute different perspectives and methods [30]. However, collaboration is difficult when disciplines use specialized language, different problem-solving styles, and incompatible assumptions about process [14, 16]. Functional diversity can also produce hierarchy and status differences, limiting contributions from less dominant disciplines [5]. Shared mental

* Corresponding author: susuyang44@163.com

models and deliberate collaboration structures are therefore important enablers of team performance [6, 13].

2.2 Social Identity and Team Innovation

Social Identity Theory explains how individuals derive part of their self-concept from group membership [27]. In organizational settings, strong subgroup identity can produce in-group favoritism and out-group differentiation [1, 15]. The common ingroup identity model argues that recategorizing members under a shared group identity can reduce intergroup bias [10]. Procedural justice and identity-based engagement further support cooperation within groups [29]. Prior work also shows that team identity can help internal innovation while creating risks for cross-team collaboration if reflexivity is weak [20]. SIDIM builds on this literature by providing a structured intervention for cultivating a positive and outward-looking design team identity.

2.3 Technology as an Identity Catalyst

Digital collaboration tools can create a neutral third space for interdisciplinary work. Collaborative virtual environments have been used to support learning communities and shared activities [23]. VR can provide shared spatial experiences that help members develop a common visual language, while industry tools and reports describe their use in design collaboration [11, 28]. AI-assisted design systems can further support collaboration by generating alternatives, surfacing relevant knowledge, and reducing routine cognitive load [2, 17, 19]. SIDIM treats these technologies not only as productivity tools but also as mechanisms for building shared context and identity.

3 Methodology and System Design

3.1 The SIDIM Framework

SIDIM is built on the premise that a strong superordinate design group identity is a primary catalyst for interdisciplinary innovation. Figure 1 shows the conceptual pathway: targeted interventions, mediated by a digital ecosystem, influence five psychological constructs and lead to improved innovation outcomes.

The five SIDIM constructs are as follows. Design Group Identification (DGI) describes the degree to which members perceive themselves as part of the interdisciplinary design team. Collective Innovation Efficacy (CIE) is the team's shared belief in its ability to perform innovative tasks [3]. Innovation Norms and Goals (ING) capture the standards and objectives that guide experimentation, constructive feedback, and knowledge sharing. Challenge Appraisal (CA) describes whether difficult tasks are interpreted as growth opportunities rather than threats. Innovation Response (IR) captures behavior related to generating, promoting, and implementing novel ideas.

3.2 Intervention Protocol

The intervention was delivered over a 12-week period. In Week 1 and Week 6, teams joined identity-building workshops in which they created a team charter, defined a shared mission, and mapped complementary expertise. Weekly rituals included demo days in the VR space and cross-pollination sessions in which members learned about colleagues' disciplines. The experimental group used the SIDIM digital ecosystem as the primary workspace so that shared digital interaction reinforced the team identity.

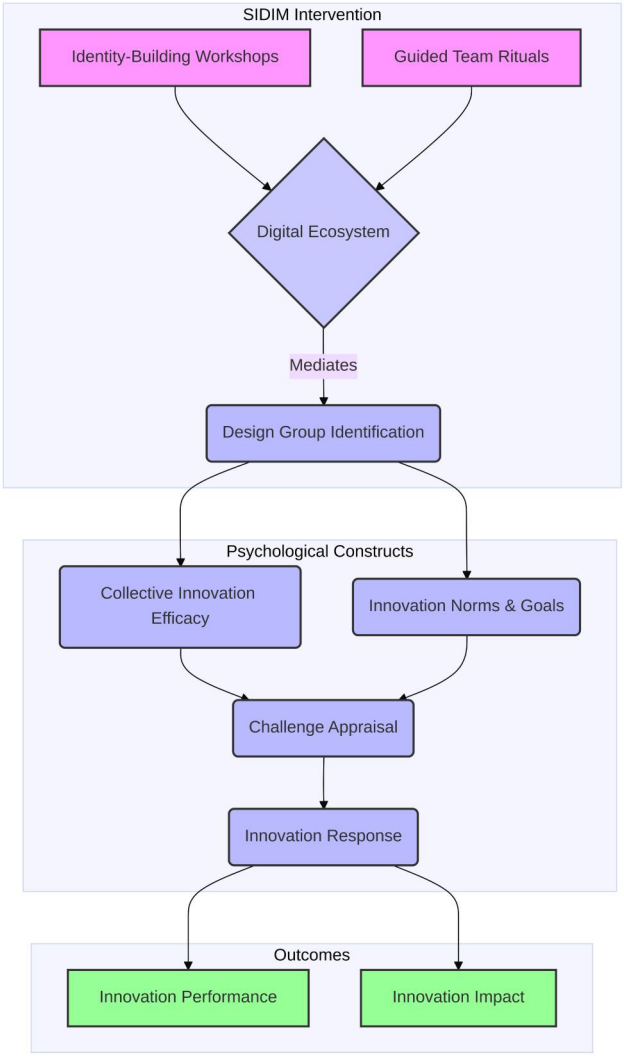

Figure 1. The Social Identity-Driven Intervention Model (SIDIM).

3.3 Digital Ecosystem

The SIDIM digital ecosystem comprised three components. The VR Co-Creation Space provided a persistent virtual project room with avatar-based meetings, 3D modeling, whiteboarding, and spatial prototyping. The AI-Assisted Design Dashboard provided generative design variations and a knowledge-management module based on natural language processing. The Digital Collaboration Hub integrated communication, file sharing, project management, VR activities, and AI tool outputs.

3.4 Study Design

We used a quasi-experimental pre-test/post-test design. The study recruited 310 participants from a multinational technology firm's R&D division and assigned them to 62 interdisciplinary teams. Each team included members from at least three of five disciplines: engineering, design, business, psychology, and computer science. The experimental group included 32 teams and received the full SIDIM intervention. The control group included 30 teams and used the firm's standard collaboration tools.

Data were collected at Weeks 0, 2, 4, 6, 8, 10, and 12. The five SIDIM constructs were measured using 9-point Likert-scale survey instruments adapted from established measures of organizational identification and perceived group success [21, 24]. Innovation outcomes included collaboration efficiency, innovation quality, business value potential, and team satisfaction. Mixed-effects models were used for longitudinal analysis, and independent-samples t-tests compared final outcomes between groups.

4 Experiments and Results

4.1 Impact on SIDIM Constructs

Figure 2 presents the temporal evolution of the five SIDIM constructs. Both groups began with comparable baseline scores. Over time, the experimental group showed steady increases across all five constructs, while the control group remained relatively flat. By Week 12, the experimental group reported higher levels of DGI, CIE, ING, CA, and IR.

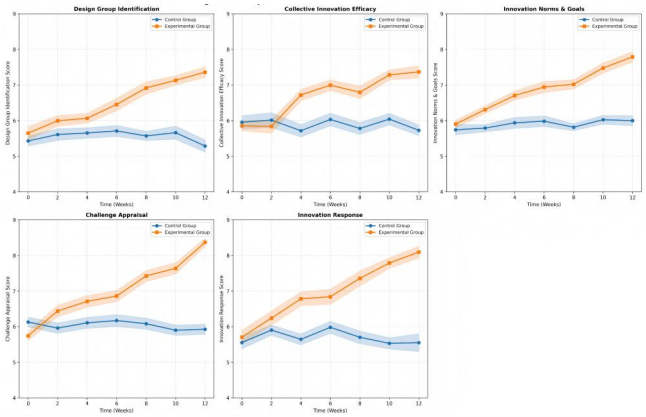

Figure 2. Temporal evolution of SIDIM model dimensions across the 12-week study period.

The DGI score in the experimental group increased from 5.6 at Week 0 to 7.4 at Week 12, compared with approximately 5.3 in the control group. CIE also increased substantially, suggesting that identity-building activities and technology-supported collaboration increased team confidence in collective innovation.

4.2 Innovation Performance Outcomes

Figure 3 compares final performance metrics. The experimental group achieved a mean collaboration efficiency score of 79.3%, compared with 64.1% for the control group. Innovation quality increased from 6.23 in the control group to 7.15 in the experimental group. Business value potential and team satisfaction also showed statistically significant improvements.

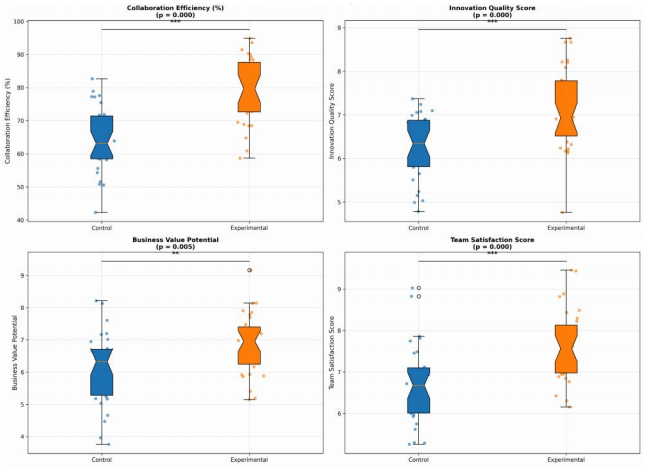

Figure 3. Performance metrics comparison between control and experimental groups at Week 12.

These results indicate that the SIDIM intervention improved both psychological enablers and observable innovation outcomes. The reported 23.7% improvement in collaboration efficiency suggests that shared identity reduced coordination loss. The 14.8% improvement in innovation quality suggests that the intervention helped teams synthesize diverse knowledge into stronger design outcomes.

4.3 Correlation Analysis

Figure 4 shows the correlation matrix among SIDIM constructs and innovation outcomes. The five constructs were strongly and positively correlated with each other, supporting the internal coherence of the model. Innovation Response showed the strongest correlations with collaboration efficiency and innovation quality, consistent with the model's assumption that psychological readiness translates into innovative behavior.

4.4 Team Diversity and Innovation Performance

Figure 5 explores how team composition interacted with the intervention. Cultural diversity was positively associated with innovation quality in both groups, but the experimental group showed a stronger relationship. Teams in the experimental group with higher cultural diversity achieved higher innovation-quality scores than similarly diverse control teams. Average team experience also related positively to collaboration efficiency, but the intervention group maintained higher efficiency across experience levels.

4.5 Technology Usage

Telemetry data from the experimental group showed increasing use of both the VR Co-Creation Space and the AI-Assisted Design Dashboard. Figure 6 shows that average weekly VR

Variable	Group	Mean	Std.Dev.	T-Statistic	P-Value	Cohen's d
Design Group Identification	Control	5.29	0.93	-9.20	<0.01	2.34
	Control	5.29	0.93			
Design Group Identification	Control	5.29	0.93	-9.20	<0.01	2.34
	Control	5.29	0.93			
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	Control	5.29	0.93			

Table 1. LDA topic modeling results on public key concerns regarding AI in vocational education

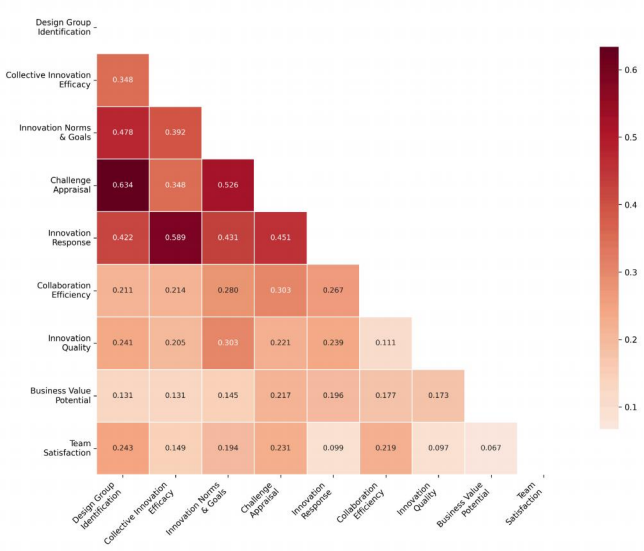

Figure 4. Correlation matrix between SIDIM constructs and performance metrics at Week 12.

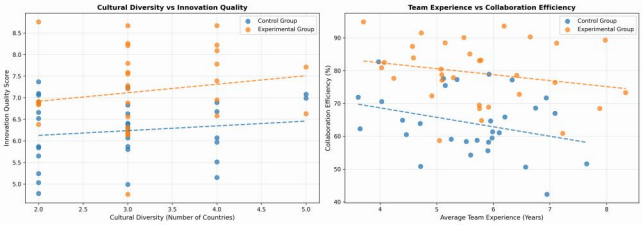

Figure 5. Impact of team diversity and experience on innovation performance.

collaboration time grew from 2.1 hours in the first two weeks to 11.5 hours in the final two weeks. AI tool usage followed a similar upward trend.

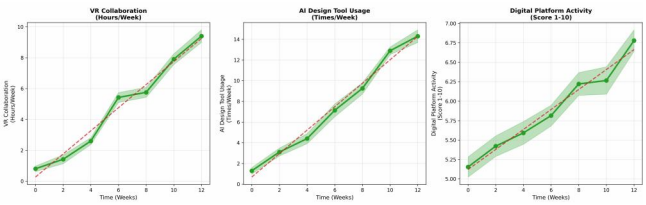

Figure 6. Technology usage patterns in the experimental group.

4.6 Temporal Evolution of Intervention Effects

Figure 7 shows the growing difference between experimental and control groups across key performance metrics. Collaboration efficiency showed the strongest divergence, reaching an advantage of approximately 15 percentage points by Week 12. Innovation quality and business value potential also improved progressively over time.

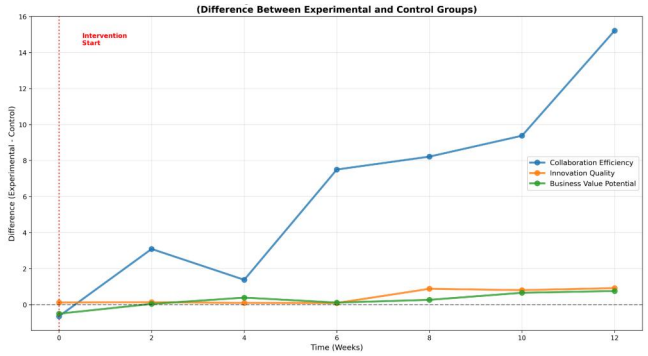

Figure 7. Intervention effects over time, represented as differences between experimental and control groups.

5 Analysis and Discussion

5.1 The Power of a Superordinate Identity

The results support the central SIDIM hypothesis: a targeted identity-focused intervention can cultivate a superordinate design team identity. The large increase in DGI suggests that team members came to view themselves less as isolated disciplinary representatives and more as participants in a shared design community. This shift is consistent with social identity theory and common ingroup identity research [10, 27].

5.2 Technology as an Identity Catalyst

The study also suggests that technology can shape social and psychological dynamics. VR created a shared environment in which disciplinary status cues were less visible, while AI-supported design tools provided neutral prompts and alternatives for discussion. These tools did not replace collaboration; rather, they provided shared contexts and artifacts around which collaboration could develop.

5.3 From Psychological Constructs to Performance

The positive correlations between SIDIM constructs and innovation outcomes indicate that the intervention's benefits were

not merely perceptual. Improved identification and collective efficacy were associated with higher collaboration efficiency, innovation quality, and team satisfaction. These findings suggest that building shared identity can be a practical route to improving interdisciplinary design performance.

5.4 Limitations and Future Research

The quasi-experimental design provides useful field evidence but does not support the same level of causal inference as a randomized controlled trial. The study was also conducted within a single technology-focused company, so future research should examine other industries and cultural contexts. Finally, the 12-week timeframe provides only a short-term view. Longer longitudinal studies could examine whether the cultivated identity and performance gains persist over time.

6 Conclusion

This paper introduced SIDIM, a social identity-driven intervention model for enhancing interdisciplinary design innovation. By combining identity-building workshops, guided rituals, VR co-creation, AI-assisted design tools, and a central collaboration hub, SIDIM helped teams develop stronger shared identity and improved innovation outcomes. The study contributes a structured model linking social identity theory to technology-mediated design work and offers a practical approach for organizations seeking to strengthen interdisciplinary collaboration.

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