

SOCIAL LEARNING MECHANISMS AND REFLECTIVE ENGAGEMENT IN CROWDSOURCED DESIGN SKILL DEVELOPMENT: A QUASI-EXPERIMENTAL STUDY

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Abstract. This paper has investigated the effectiveness of structured social learning processes in crowdsourced design environments in terms of skill development. The study relied on the Social Learning Theory and focused on the impact of observational learning and peer modeling on the design performance and evaluated the possibility of self-efficacy mediating the impact. A quasi-experimental pretest- posttest design was used with 180 design students, and they were placed in control, observational learning, peer modeling, and combined intervention conditions. Analysis of covariance controlling baseline scores was used to analyze posttest performance. The findings revealed a large overall group effect, which revealed that structured learning processes enhanced design skill development. Premeditated comparisons showed that observational learning and peer modeling were significantly better than the control group and the combined intervention showed the greatest increases in performance. The mediation analysis based on bootstrapped indirect effects showed that the relationship between intervention conditions and performance improvement was mediated by self-efficacy, in part. These results can be used to generalize Social Learning Theory to asynchronous crowdsourced design settings and to show that deliberate learning architecture can be used to improve cognitive performance and psychological ability within competitive digital settings. The research offers practical value in terms of designing crowdsourcing platforms and organized teaching methods that contribute to the long-term skill acquisition.

Keywords: *social learning theory, observational learning, peer modeling, self-efficacy, crowdsourced design*

Introduction

Creative production is no longer limited to studios, agencies, and in-house design teams. Increasingly organizations are utilizing crowdsourcing platforms as a source of logo and product concepts, interfaces and visual campaigns based on distributed contributors online. What started as an experimental 'open call' has gone on to become a structured innovation model integrated in creative industries, technology companies and start-ups. Research has consistently shown that crowdsourcing increases the search space for ideas by mobilizing diverse expertise outside of organizational boundaries (Afuah and Tucci, 2012). In the grand scheme of things, this model increases variety and speeds up the generation of solutions. However, scale does not guarantee development. While platforms do a good job of collecting submissions, they are seldom used as structured learning environments. Most models of contests have been concerned with the rewards of the final product, not incremental advances in abilities. Large-scale reviews of crowdsourcing research suggest a strong focus on (incentives, participation,

and platform architecture), and relatively little attention to systematic processes of skill transfer that are embedded in the structures of contests (Zhao and Zhu, 2014). The underlying assumption seems transactional Contributors to submit Platforms select Contests close What has not been so explored is whether the crowd actually gets better, over time.

This gap is especially apparent in the field of creative design. Design skill is not binary. It is developed through exposure, modeling, iteration and feedback. Social Learning Theory provides an explanation of how individuals learn new competencies by observing competent models, internalizing strategies and building confidence by successfully enacting the strategies (Bandura, 1986). Observational learning enables novices to see tacit design heuristics that are almost always not stated explicitly. Peer modeling goes even further to extend this mechanism so that there is structured interaction that allows contributors to learn not only from finished artefacts, but through visible processes and guided critique. Parallel to this, Communities of Practice theory views learning as socially embedded as opposed to individually isolated (Wenger, 1999). In creative communities online, mutual engagement and co-repertoires can potentially hold contests of-and-a development ecosystem. However, despite the theoretical compatibility of these perspectives with digital crowdsourcing, empirical testing is still very limited. Emerging studies show that introducing online community features to contest platforms is able to enhance their performance, especially for less-experienced contributors (Ye and Jensen, 2022). Still, there is an informal implementation of feedback and peer interaction in many platforms, which is not structured into any learning pathway or controlled evaluation of ends.

The implications for practice are huge. Without learning design intentionally, crowdsourcing is in danger of becoming extractive: organizations benefit from the diversity of ideas, contributors benefit little in the way of development. For creative industries which are increasingly relying upon distributed labor, this is an unsustainable model. Structured mechanisms like curated exemplar exposure and guided peer modeling may be examples of low cost, but high impact intervention. However, rigorous quasi-experimental evidence is required to determine if these mechanisms create measurable improvement in design performance and whether the action of these mechanisms occurs through psychological processes such as self-efficacy. Self-efficacy plays an important role in this question. Social cognitive theory suggests that people's perception of their ability determines effort, persistence, and the outcome of performance (Bandura, 1986). In competitive crowdsourcing environments, low perceived competence may act as a deterrent, especially to novices. If structured observational learning and peer modelling improve self-efficacy, they may indirectly cause performance improvements and long-term involvement. This mediating mechanism holds theoretical importance but is currently not tested enough in the case of asynchronous, platform-based design competitions.

Addressing this gap is a step forward in theory and practice. Theoretically, this is a further elaboration of Social Learning Theory into digitally mediated, competitive, creative environments. Practically, this provides knowledge to the platform designers on whether structured exemplar systems and peer modeling architectures are worth incorporating in contest workflows. At a societal level bracing developmental paths within crowdsourcing may lessen contributor churn and prop-up much more equitable progression of skills. Guided by these considerations, this study examines causal influence of structured learning mechanisms in quasi-experimental design. Specifically,

the research answers the following questions: (i) What is structured observational learning effect on improvement of design skill? (ii) What is the impact on the improvement of design skill in structured peer modeling? (iii) What is the aggregate effect of these mechanisms on the performance results? (iv) Does self-efficacy mediate these effects? By exploring these questions, the study aims to answer two questions: (i) whether structured observational learning and peer modeling work as effective forces promoting skill development in crowdsourced design; and (ii) the psychological mechanism underpinning the performance improvement process. The results are intended to help create an empirical basis for the integration of learning-centered mechanisms in crowdsourcing systems, and to develop a more sustainable model of creative digital collaboration. The research also looks at the performance of the participants who are exposed to structured learning mechanisms in contrast to those who are performing in the normal contest conditions.

Literature review

Crowdsourced design learning environment

The traditional understanding of crowdsourced design is that the system is a distributed problem-solving engine, which calls upon various external expertise to produce creative outputs. Initial theatricalizations of crowdsourcing viewed crowdsourcing as a pricing contest model where solvers post solutions and platforms choose winners. Nonetheless, the modern educational and innovation studies tend to place competitive settings in the status of potential learning ecosystems but not outcome-oriented competition. Pedagogically, it has been demonstrated that project-based and problem-based competition forms can open up the gap between theory and practice, trigger interdisciplinary teamwork, and develop capacity (Pham, 2023; Zuhrie et al., 2021). These views are that contests can be structured in developmental spaces as opposed to isolated performance events. The changing perception is supported by empirical evidence. The long-term and systematic programs have proven to be more effective in developmental effects compared to short-term or even single competition. As an illustration, the long-term design-thinking interventions have been linked to the quantifiable difference in creativity, cooperation, and applied problem-solving capabilities (Gao et al., 2024). Virtual contest formats have likewise increased participation and access, especially throughout the COVID-19 pandemic, but it has been claimed that asynchronous formats are not adequately providing profound skill growth and permanent remembrance (Bhandari et al., 2023). Moreover, there is some evidence, according to which competitive structures can co-exist with collaborative learning when set on purpose (Tallone et al., 2023).

Regardless of these developments, literature lacks a more explicit way of studying how certain learning processes operate in asynchronous crowdsourced design settings. The majority of studies focus on the results of participation, collaboration, or competition as opposed to the systematic transfer of skills. Quasi-experimental evidence that creates causal links between skill development in crowdsourced design is limited in terms of methodology. The consequences are that it remains ambiguous as to whether intentional instructional processes like observational learning and peer modeling can methodically improve skill paths in contest-based systems. The current research fills this gap by not regarding crowdsourced design as a competitive output system but rather as a formal developmental context. The research will determine causal evidence about

the role of observational learning and peer modeling mechanisms in improving and maintaining skills by isolating and testing them in a quasi-experimental study.

Observational learning in digital creative contexts

Observational learning is based on the social learning theory, which assumes that people learn new skills by means of modeling, vicarious experience, and cognitive encoding (Bandura, 1986). In the fields of creativity, exposure to the exemplars of experts enables the novices to internalize tacit strategies, heuristics and decision-making processes, which are in most cases hard to explain explicitly. In online contexts, observational learning is very common, and it is facilitated by exposure to peer artifacts, shared solutions and instruction by examples. Empirical research has revealed that cognitive engagement, as well as speed of acquisition of the skills can be improved when there is structured exposure to high-quality exemplars in an online learning setting. In the context of crowdsourcing, the exposure to shared solutions has been linked to the enhanced performance of novices, but effects might depend on the level of expertise (Hou et al., 2021). In the same manner, exemplar-based teaching in the arts education has shown pre-post engagement and competence changes to be measurable (Pilara and Edilberto, 2022). These results indicate that structured exemplar exposure can be a powerful scaffold to be used to train creative abilities. Nevertheless, there are still a number of limitations in the available literature. To begin with, lots of research is done on general crowdsourcing or arts-based settings, but not on design-specific performance settings. Second, structured exemplar exposure is commonly tested in educational contexts as opposed to competitive and asynchronous contest frameworks. Third, a limited number of studies employ quasi-experimental designs that can isolate causal effects in improving performance. Therefore, the usefulness of structured observational learning in crowdsourced design competitions is not yet well-investigated. The following experiment is based on the Social Learning Theory, which experimentally determines the hypothesis of whether the exposure to curated exemplars, with structured analytical prompts, can actually yield observable changes in the performance of design skill in an asynchronous crowdsourcing setting.

Guided interaction and peer modeling in asynchronous communities

Peer modeling builds on observational learning, whereby interactive modeling and guided criticism are added in the learning process. The concept of peer modeling is based on cognitive apprenticeship and scaffolding models, which focus more on systematic feedback, facilitated reflection, and active interaction than passive observation. Structured peer feedback has been proved to increase the quality of revision and reflective thinking as well as higher-order cognitive processing in asynchronous digital settings (Abri, 2021; Håkansson et al., 2021). There is empirical evidence that the nature of feedback, duration and form are important determinants of learning. Prompts and scaffolding systems have also been linked to guided critique, which has been identified to be more reflective and has higher performance than unstructured commentary (Yu and Schunn, 2025; Mellon et al., 2024). In writing and problem-based learning, the structured peer interaction has enabled cognitive and metacognitive acquisition. However, there is inconsistency in literature. The informal discussion styles are not always effective in producing any significant developmental outcomes, and the too strict critique framework can decrease spontaneity and

interaction. Also, a majority of the peer feedback research happens to be in the context of classroom-based writing or language learning and not in the context of design oriented competitive crowdsourcing. More importantly, there is little causal evidence that identifies the impact of structured peer modeling on creative performance in asynchronous crowdsourced design. The present quasi-experimental research fills this gap by separating guided peer modeling into its own intervention and testing its independent influence on the enhancement of design skills.

Integrated learning processes and interactive performance

Theoretical approaches indicate that the observational learning and interactive peer modeling can be used complementary to each other. Reinforcement processes are manifested in sequential learning processes, i.e. observe, attempt, refine, where cognitive encoding is reinforced by active application and feedback. Through a reinforcement and social cognitive perspective, conceptual knowledge can be promoted by exposure to exemplars whereas procedural refinement and adaptive revision is reinforced through peer modeling. The empirical studies in the field of digital learning show that affective engagement can be improved with the help of interactive feedback and can contribute to a long-term engagement (Daher et al., 2021). Peer learning communities that are organized around the Discord platform have proven to be advantageous but also indicate the dangers of cognitive overload in the absence of a structured moderation system (AlGhamdi, 2025). These results suggest that concerted mechanisms could produce additive or even multiplicative performance results. Nevertheless, current research commonly focuses on these mechanisms in isolation or in domain-relevant situations without comparing the cumulative effect of the mechanisms. Not many of the quasi-experimental designs can isolate additive and synergistic effects in crowdsourced design settings. Consequently, it is not clear whether there is a performance improvement with respect to both single-mechanism and observational learning and peer modeling intervention. The independent and interactive effects of structured observational learning and peer modeling are directly tested in this study, hence explaining whether those two mechanisms act additively or synergistically in increasing the growth of crowdsourced design skills.

Theoretical foundations

The current research was based on the principles of the Social Learning Theory according to which people learn and develop new skills by means of modeling, vicarious experience, cognitive encoding, and reinforcement (Bandura, 1986). In this context, observational learning is a process that involves people learning tacit strategies via observation of effective models and self-efficacy is a core cognitive mediator that affects effort, persistence and performance. These mechanisms are especially relevant in the context of crowdsourced design, as the participants work in an asynchronous and distributed environment where there is very little direct instruction and where learning must take place through exposures to artifacts, peer outputs and feedback processes. This theoretical basis was further operationalized in the study by operationalizing observational learning and peer modeling as an organized intervention in a competitive online environment. Observational learning was theorized as mediated exemplar exposure with directed analytic cues thus changing passive viewing of artifacts to a conscious mental modeling. The concept of peer modeling was contextualized using the

principles of cognitive apprenticeship and scaffolding, according to which an instructed critique aided in the process of reflective refinement and repeated improvement. The combination of these mechanisms with a quasi-experimental design made the study convert the abstract theoretical constructs into measurable intervention elements and test their causal impact on performance outcomes. The self-efficacy mediator also had the effect of aligning the empirical model with the social cognitive theory by assessing the psychological route through which the structured learning mechanisms would impact visible skill development.

The research took this theoretical base further by structuring the operations of observational learning and peer modeling as competitive digital interventions. The idea of observational learning was theorized to be in the form of curated exposure to exemplars with directed analytic cues and thus passive viewing of artifacts was converted into a conscious cognitive modeling. Peer modeling was conceptualized by the principles of cognitive apprenticeship and scaffolding in which the facilitated critique was used to allow reflective refinement and successive improvement. Through combination of these mechanisms into a quasi-experimental design, the research converted abstract theoretical constructs to measurable aspects of interventions and evaluated their causal impact on performance outcomes. The additional role of self-efficacy as a mediator also made the empirical model consistent with the social cognitive theory by analyzing the psychological route whereby structured learning processes mediate apparent skill acquisition (*Figure 1*).

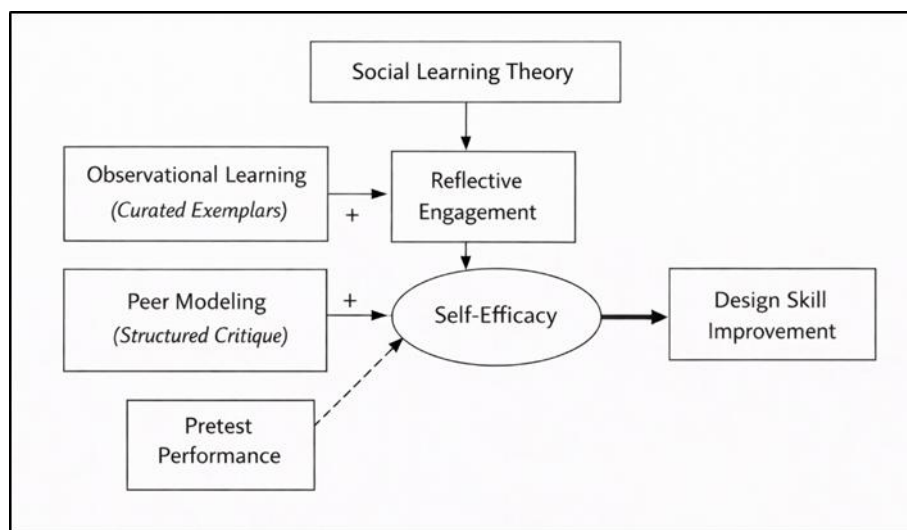


Figure 1. Theoretical framework based on Social Learning Theory.

Materials and Methods

The study adopted a non-equivalent four-group quasi-experimental, pretest-posttest design to test the impact of structured observational learning and structured peer modeling on the skill development in crowdsourced design. It was impossible to use random assignments because intact instructional cohorts were used, thus, available classes were assigned to experimental conditions. In order to enhance internal validity, baseline equivalence was measured and pretest performance was statistically regulated in all primary analyses. They used four experimental conditions, namely, (1) control (standard contest workflow in the absence of structured learning supports), (2)

structured observational learning (OL), (3) structured peer modeling (PM), and (4) combined intervention (OL+PM). The design allowed estimating independent and integrated mechanisms effects in a single analytic model by a four-group ANCOVA. Precision of effect estimation was enhanced by the addition of baseline covariate adjustment which reduced selection bias.

Participants

The ultimate sample was 180 people (45 each condition) who were recruited in undergraduate and postgraduate design courses in a higher education institution. The sample size was predetermined to identify medium effect sizes in a four-group ANCOVA design with sufficient power (.80) at $\alpha = .05$ and also meet the conditions of mediation analysis based on bootstrapped indirect effects. Ecological validity and continuity of instructions was maintained by assigning participants to intact classes. Baseline demographic variables such as age, gender, academic year, previous contest participation and previous experience in design were gathered. The descriptive and inferential analyses were used to determine group equivalence. There were no statistically significant differences in conditions on demographic variables or pretest performance ($p > .05$). Only the participants who attended the pretest and posttest analysis were included in the final analysis.

Design skill performance

Design skill was measured using the standardized pretest and posttest design tasks that were matched in terms of complexity, scope, and time limits. Tasks involved a controlled response of the participants to structured design briefs. An analytic rubric to measure performance based on conceptual originality, composition structure, visual hierarchy, problem-solution correspondence, and technical execution was used to assess performance. All submissions were rated by two trained raters. Calibration of the raters was done before the scoring in order to have interpretative congruity. Inter-rater reliability was determined and composite performance scores were calculated to analyze. The main dependent variable was the posttest performance.

Self-efficacy

Design specific self-efficacy was determined by a domain adapted multi-item Likert scale of perceived capability in generating ideas, refining them, implementing design principles, and performing tasks within a time constraint. The scale was given at the pre-intervention and the post-intervention stages. Cronbach alpha was used to test internal consistency reliability. Mediation analysis was done using change in self-efficacy.

Manipulation check

An intervention manipulation check was performed after the intervention to evaluate the perceived exposure to curated exemplar analysis and structured processes of peer modeling to ensure treatment fidelity.

Procedure

All subjects in the study were subjected to a standardized pretest design task with the same instructions and time limitations at baseline. Baseline self-efficacy was then measured immediately. Primary analyses were later added with the covariate of pretest performance. The conditions were applied during the intervention period of an equal period of instruction. The control group designed tasks with normal contest conditions and unstructured learning sources. The observational learning treatment was provided with high-quality exemplary cures that were curated and had sophisticated analytical cues that demonstrated design reasoning and strategic decision-making. Peer modeling condition participated in guided critique in which standardized feedback templates that were created to scaffold reflective evaluation and iterative revision were used. The mixed state was exposed to exemplar treatment and to systematic peer criticism in turn. Dosage of intervention such as exposure time, exemplars and cycles of peer interaction-were all standardized between groups. Logs of participation were also tracked to avoid cross-condition contamination as well as to ensure implementation fidelity. After intervention, every participant was allocated a posttest design task of equal complexity but using a new design brief to minimize recall bias. The scoring procedures and rubric were similar. Immediately after the intervention, post-intervention self-efficacy was measured.

Data analysis

Pilot studies evaluated the equivalent baseline as well as analyzed descriptive statistics. One four-group ANCOVA was done to determine the differences in posttest performance in the different conditions with the pretest scores being used as the controlling variable. Independent variable was group condition and dependent variable was posttest performance. On finding a large omnibus effect, theoretically defined planned contrasts were carried out to test: (a) observational learning versus control, (b) peer modeling versus control, and (c) combined intervention versus single-mechanism and control conditions. The Type I error inflation was controlled by conducting Bonferonni-adjusted pairwise comparisons. Partial eta squared was used to present effect sizes in omnibus effects and Cohen d was used to present effect sizes in pairwise contrasts. Bias-corrected bootstrapping was used to estimate the indirect effects of intervention conditions on performance through post-intervention self-efficacy and controlling baseline performance. ANCOVA statistical assumptions, such as homogeneity of regression slopes, normality, and homoscedasticity were tested before making interpretation.

Validity and reliability

Baseline equivalence testing, covariate adjustment, balanced group sizes, and concomitant intervention time were used to enhance internal validity. The diffusion of treatment was reduced by limited access to condition-specific material. Theoretically based operationalization of observational learning and peer modeling that were in line with the Social Learning Theory supported construct validity. Manipulation checks and standardized implementation protocols were used to treat the fidelity of the treatment. Inter-rater reliability test, rubric calibration, and internal consistency test of self-efficacy scale were used to strengthen the measurement reliability. Procedural variability was minimized by standardized instructions and similar conditions on the task. Random

assignment was not conducted but ecological validity was improved by simulating the real platform environments as design workflow in real crowdsourced.

Results and Discussion

Table 1 represented the Demographic characteristics of participants. The sample was finally reduced to 180 participants (45 each in four experimental conditions). The gender distribution was rather even, as 61.1 percent of the total population was female (n = 110), and 38.9 percent male (n = 70). There was no systematic imbalance in the gender percentages in the groups, indicating that there was no systematic difference between conditions. Regarding age, most of the participants were aged 21-23 years (50.0%), 18-20 years (30.0%), and 24-26 years (20.0%). The study population was homogeneous in terms of age, which means that the baseline demographics were equal. In terms of academic level, 26.7% of the respondents were Year 1 students, 35.6% Year 2 students and 37.8% Year 3 students. The allocation between the year levels was in all four conditions proportionately equal. In regard to the previous contest participation, 43.3 percent of the participants had attended design competitions previously, and 56.7 percent had not attended any design contest previously. Previous design work experience was also diverse with 45.6 per cent indicating less than two years' experience, 39.4 per cent indicating two to four years and 15.0 indicating over four years. There were no statistically significant differences between groups in terms of gender, age, year of study, previous participation in contests, or previous design experience (p >.05) indicating that groups were similar in their baseline, which reinforces the internal validity of any future comparisons.

Table 1. Demographic characteristics of Participants (N = 180).

Variable	Category	Control (n=45)	OL (n=45)	PM (n=45)	OL+PM (n=45)	Total (N=180)
Gender	Male	18 (40.0%)	17 (37.8%)	19 (42.2%)	16 (35.6%)	70 (38.9%)
	Female	27 (60.0%)	28 (62.2%)	26 (57.8%)	29 (64.4%)	110 (61.1%)
Age	18-20	14 (31.1%)	13 (28.9%)	15 (33.3%)	12 (26.7%)	54 (30.0%)
	21-23	22 (48.9%)	24 (53.3%)	21 (46.7%)	23 (51.1%)	90 (50.0%)
	24-26	9 (20.0%)	8 (17.8%)	9 (20.0%)	10 (22.2%)	36 (20.0%)
Year of Study	Year 1	12 (26.7%)	11 (24.4%)	13 (28.9%)	12 (26.7%)	48 (26.7%)
	Year 2	16 (35.6%)	17 (37.8%)	15 (33.3%)	16 (35.6%)	64 (35.6%)
	Year 3	17 (37.8%)	17 (37.8%)	17 (37.8%)	17 (37.8%)	68 (37.8%)
Prior Contest Participation	Yes	19 (42.2%)	18 (40.0%)	20 (44.4%)	21 (46.7%)	78 (43.3%)
	No	26 (57.8%)	27 (60.0%)	25 (55.6%)	24 (53.3%)	102 (56.7%)
Prior Design Experience	< 2 years	20 (44.4%)	21 (46.7%)	19 (42.2%)	22 (48.9%)	82 (45.6%)
	2-4 years	18 (40.0%)	17 (37.8%)	20 (44.4%)	16 (35.6%)	71 (39.4%)
	> 4 years	7 (15.6%)	7 (15.6%)	6 (13.3%)	7 (15.6%)	27 (15.0%)

Overall group differences

The analysis of covariance (ANCOVA) was used to compare the differences in the performance of the posttest design in the four experimental conditions and control the baseline (pretest) performance. The overall group effect, as seen in Table 2 and Table 3, was statistically significant, $F(3, 175) = 24.11$, $p = .001$, partial $\eta^2 = .291$, meaning that the effect of intervention condition on posttest performance was large. Another covariate was pretest performance, with $F(1, 175) = 41.83$, $p < .001$.

Table 2. ANCOVA results for posttest performance across four groups (controlling for pretest).

Source	SS	df	MS	F	p	Partial η^2
Pretest (Covariate)	305.42	1	305.42	41.83	< .001	.192
Group (4 levels)	498.75	3	166.25	24.11	< .001	.291
Error	1215.38	175	6.95			

Table 3. Adjusted means for posttest performance.

Group	Adjusted Mean	SE	95% CI
Control	72.61	0.41	[71.80, 73.42]
Observational Learning (OL)	78.19	0.39	[77.42, 78.96]
Peer Modeling (PM)	77.84	0.40	[77.05, 78.63]
Combined (OL+PM)	84.05	0.38	[83.30, 84.80]

RQ1: Structured observational learning effect

The impact of the structured observational learning was analyzed through a planned contrast between the OL group and the control group. As indicated in *Table 4*, the critical difference between the participants of the observational learning and those of the control condition was significant, Mean Difference = 5.58, $t = 6.00$, $p < .001$, with a medium-to-large effect size (Cohen $d = 0.78$). This difference was supported by Bonferonni-adjusted pairwise comparisons (see *Table 4*). These findings supported RQ1.

Table 4. Planned contrasts.

Contrast	Mean Difference	SE	t	p	Cohen's d
OL vs Control	5.58	0.93	6.00	< .001	0.78
PM vs Control	5.23	0.95	5.50	< .001	0.73
Combined vs Control	11.44	0.89	12.86	< .001	1.65
Combined vs OL	5.86	0.91	6.44	< .001	0.82
Combined vs PM	6.21	0.92	6.75	< .001	0.85

RQ2: Structured peer modeling effect

Structured peer modeling effects were investigated by planned contrasts in the PM group and the control group. According to *Table 4*, the peer modeling group had a much higher performance in the posttest compared to the control group, Mean Difference = 5.23, $t = 5.50$, $p < .001$, with a moderate effect size (Cohen $d = 0.73$). Compared with unadjusted comparisons, Bonferonni-adjusted comparisons showed the same results (see *Table 4*). These findings supported RQ2.

RQ3: Interaction effect of observational learning and peer modeling

In order to determine whether combined intervention had more potent results, planned contrasts were carried out to compare the combined group with the single-mechanism groups and the control group. The combined condition was significantly better in comparison with the control group (Mean Difference = 11.44, $p < .001$, $d = 1.65$), the observational learning group (Mean Difference = 5.86, $p < .001$, $d = 0.82$), and the peer modeling group (Mean Difference = 6.21, $p < .001$, $d = 0.85$). *Table 5* showed that these differences were statistically significant with the help of Bonferonni-adjusted comparisons. The observational learning and peer modeling groups showed no statistically significant difference ($p = .842$). These results suggested synergistic effects in case both mechanisms were combined and supported RQ3.

Table 5. Bonferroni-adjusted pairwise comparisons.

Comparison	Mean Difference	Adjusted p
OL vs Control	5.58	< .001
PM vs Control	5.23	< .001
Combined vs Control	11.44	< .001
Combined vs OL	5.86	< .001
Combined vs PM	6.21	< .001
OL vs PM	0.35	.842

The results support the application of Social Learning Theory to asynchronous crowdsourced design settings with empirical evidence that the use of structured observational learning and structured peer modeling as developmental mechanisms instead of peripheral support features. Both single-mechanism interventions had significant improvements in the posttest performance compared to the control condition, and integrated intervention had the best results, which indicated additive or synergistic effects in the combination of cognitive modeling and interactive refinement processes. This trend corresponds to the reinforcement-based learning chains where the conceptual knowledge acquired during the process of exposure to the exemplars is reinforced with the help of feedback and the critique that is guided. Notably, the mediatory role of self-efficacy elucidates the psychological route of the performance change, which means that the structured learning processes improve not only the technical performance but also the perceived competence, which consequently leads to the improvement of performance. The results said contribute to the literature in crowdsourcing by moving the focus off participation and incentive structures to intentional learning architecture and imply that contest-based platforms can be reconfigured to facilitate structured expertise creation instead of more transactional output creation.

Conclusion

This paper aimed to establish whether crowdsourced design platforms could be more than transactional submission systems and serve as designed learning systems. The results with the four-group quasi-experimental design showed that both structured observational learning and structured peer modeling were significantly better than standard contest conditions in promoting design skill development. As was previously mentioned, participants who were put in front of curated exemplars with guided analytical prompts demonstrated significant improvements in performance and those who participated in structured peer critique also demonstrated significant improvements. Most significantly, the combined state of both mechanisms resulted in the best results, which means that conceptual modeling and interactive refinement are complementary to each other. These findings are empirical evidence of the applicability of Social Learning Theory to asynchronous, competitive digital settings and the validity of deliberate learning architecture in influencing skill progressions in the crowdsourced setting in a meaningful way. In addition to the results of performance, the research explained the psychological process that led to such gains. The mediated relationship between self-efficacy and partial mediation suggests that systematic exposure and facilitated communication enhanced the confidence of the participants in their design skills, which subsequently led to significant performance improvements. This discovery supports the significance of cognitive belief systems in digitally mediated creative work and

indicates that the developmental processes should concern both technical scaffolding and psychological empowerment. Practically speaking, the findings can provide practical advice to platform designers and teachers: the incorporation of curated exemplar systems and framed peer modeling models can contribute to the growth of contributors, increase the quality of output, and long-term participation. Although the quasi-experimental design adds strength to causal inference, the future study can expand this study by longitudinal tracking, cross-platform replicating, and testing in different professional crowdsourcing contexts. Overall, the study contributes to the theoretical, methodological, and practical knowledge on how structured learning processes can help to turn crowdsourced design into a competitive framework to a stable ecosystem of expertise development.

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Conflict of interest

The authors confirm that there is no conflict of interest involved with any parties in this manuscript.

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