

# ENHANCING SKILL TRANSFER IN CROWDSOURCED DESIGN: A CONCEPTUAL AND COMPUTATIONAL FRAMEWORK

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**Abstract.** Crowdsourcing is a common approach to finding creative solutions through distributed contributor networks. Threadless, Top Coder, and InnoCentive platforms use open contests to support innovation, but they do not focus on long-term skill improvement. The restricted system reduces the available chances for knowledge exchange and prolonged participant engagement. The current crowdsourcing systems do not provide organized approaches to asynchronous skill transfer, producing knowledge-sharing, mentoring, and collaborative learning deficits. Research has mainly focused on real-time coordination instead of skill acquisition processes through decentralized collaboration. The research develops a conceptual model that combines Social Learning Theory with Communities of Practice to build better skill transfer capabilities in creative crowdsourcing projects. The proposed framework utilizes observational learning, peer modeling, self-efficacy development, and structured community participation to establish an interactive learning environment that sustains continuous engagement and expertise advancement. The research utilizes qualitative methods through crowdsourcing experiments and computational approaches to discover successful ways of skill dissemination. The research produces theoretical and practical advancements by discovering methods to boost participant retention and knowledge acquisition and sustain crowdsourcing platforms. Research results will generate practical solutions to develop skill-based crowdsourcing platforms that increase creativity and maintain participant retention.

**Keywords:** *crowdsourcing, asynchronous skill transfer, social learning theory, collaborative learning, engagement*

## Introduction

Crowdsourcing has become a popular method for organizations to source creative solutions by leveraging the skills and ideas of large, distributed groups. Platforms like Threadless, Top Coder, and InnoCentive allow companies to crowdsource design, software, and innovation through open contests (Afuah and Tucci, 2012). However, most crowdsourcing initiatives focus on one-off challenges rather than sustained collaboration. Once a solution is submitted, there are limited opportunities for skill development and transfer between participants (Zhao and Zhu, 2014). This highlights the need for techniques that enable creative crowd members to learn from each other. While some crowdsourcing platforms contain forums for knowledge sharing, participation in these spaces remains relatively low (Riedl et al., 2013). Previous literature on collaboration technologies has focused on the level of real-time work coordination more than on sharing creative problem-solving skills (Kittur et al., 2011). This paper points out that guidelines from education and mentoring have hardly been incorporated into crowdsourcing systems to promote skill acquisition (Ahn et al., 2021). There is also a shortage of theory to support the design of computational methods for

finding complementary skills of participants, presenting them with new material, and arranging the learning process in crowdsourcing communities. This research seeks to fill these gaps by proposing new, more general methods of transferring skills for creative crowdsourcing. To design new, more general approaches to skill transfer in creative crowdsourcing, it is necessary to borrow concepts from other domains, including education, creativity, human-computer interaction, and computational co-creativity (Steils and Hanine, 2022). A qualitative methods approach combining crowdsourcing experiments with qualitative techniques will be used to design and evaluate the skill transfer techniques. This research will produce new theoretical insights and practical methods to enhance learning and sustainability in crowdsourcing ecosystems. Today, there is a growing trend in using the crowdsourcing strategy for seeking innovative solutions from a wide and diverse base of online participants (Afuah and Tucci, 2012). The common crowdsourcing strategies are the contest-based model, micro task-based model, and peer production model (Zhao and Zhu, 2014). However, most of the crowdsourcing endeavors focus on a contest-type approach rather than prolonged engagement of people, thus constraining the development of skill sets among participants (Riedl et al., 2013). Community participation and knowledge acquisition are critical for strong crowdsourcing communities' development (De Vreede et al., 2021).

Several works have investigated knowledge sharing using discussion boards and peer reviews of crowdsourcing platforms (Ahn et al., 2021), but such activities are still scarce. There was more emphasis in prior work on real-time coordination than there was on the communication of creative abilities throughout synced methods (Kittur et al., 2011). Crowdsourcing platforms have the potential for massive scale because they draw from a large and always available audience. However, they are still unlocking the full potential of the crowd fully (Lykourantzou et al., 2021). This research tackles these gaps by designing computational approaches for complementarity skill detection, method introduction to participants, and organizing learning within crowdsourcing communities. Crowdsourcing is currently a common phenomenon involving soliciting ideas from an organization's large and unbounded population. Nevertheless, most crowdsourcing endeavors are designed from the lens of one-time contests or micro jobs, not from a continuous cooperation perspective (Zhao and Zhu, 2014). This reduces the possibility of participants gaining new skills at a particular phase in life. Hence, they tend to disengage and leave the organization (Riedl et al., 2013). Education must continue to create healthy crowdsourcing communities (De Vreede et al., 2021). Although some platforms have included forums, peer assessments, and mentoring for knowledge-sharing purposes (Ahn et al., 2021), people's activity in those spaces remains limited, and there are no trends in participants' developmental levels over time tuned to the participants' skill levels (Oppenlaender et al., 2020). There is no conventional approach to the key skills discovery, the introduction of the participant to the learning resources, and the learning process itself.

This paper aims to fill these gaps by presenting strategies for improving skill transfer between participants in creative crowdsourcing communities. The skill exchange is expected to improve crowdsourced solutions' variety, quality, and creativity, which will be directly important to organizations seeking innovative solutions. These techniques will be applied in areas like writing, graphics, product design, and data sciences. This study seeks to produce novel theoretical contributions to the field of learning in crowds while offering a set of actionable approaches for enhancing the long-term participation

and skill acquisition of crowdsourcing communities. The lack of formal, asynchronous methods of skills sharing is an important limitation to the potential benefits of crowdsourcing. Future research in this domain could contribute to better practice of engagement, learning, and performance in crowd-based creative work. This study seeks to examine and discover computational methods that successfully aid asynchronous skill transfer among participants in creative crowdsourcing competitions. Furthermore, the study aims to uncover new theoretical understandings of the collaborative learning dynamics that occur inside these decentralized communities. This research aims to design operational methods that support ongoing engagement and continual skill development, thereby enhancing crowdsourcing platforms' long-term participation, learning dynamics, and creative production.

A more specific statement about the research gap is needed to enhance the study's motivation by describing the weaknesses of existing crowdsourcing models and their effect on skill transfer. Threadless and Top Coder are innovation platforms, but they mostly operate through short-term contests that focus on completing tasks instead of supporting long-term learning development. Task-focused problem-solving keeps participants separate from one another rather than letting them develop their skills together through shared experience, thus preventing lasting professional growth. The peer assessment and forum feature on crowdsourcing platforms show limited usage because they lack proper mentoring systems, effective engagement methods, and appropriate incentive programs. Academic attention has mostly focused on real-time collaboration during work coordination, yet insufficient work exists for developing theoretical and computational models to enhance skill transfer in asynchronous crowdsourcing communities. The study achieves greater impact by presenting these shortcomings at the beginning of the paper, including the lack of skill-matching algorithms, insufficient social learning adoption, and unstructured learning pathways. The section becomes stronger when it includes specific examples demonstrating how these gaps block innovation and retention in creative crowdsourcing environments.

## Results and Discussion

Creative crowdsourcing has emerged as a popular means of accomplishing creative tasks by leveraging the efforts of large, diverse groups of people, often online. Effective creative crowdsourcing involves successfully managing different stages of the process, including idea generation, selection, implementation, and communication, while ensuring satisfaction among both the organization and the participants (Steils and Hanine, 2022). Participants in crowdsourcing initiatives exhibit a broad range of skill levels. While some of the contributors can be highly experienced and knowledgeable, others are raw or have no experience at all (Sun et al., 2015). This variance can be seen as a strength and a weakness. Many researchers have identified that one of the main challenges in the use of group interventions is the ability to transfer skills from the more proficient members to the less proficient members; thus, identifying efficient ways of achieving this can go a long way in improving the results. This paper looks at previous literature concerning techniques to encourage skill acquisition during creative crowdsourcing. The emphasis is placed on systematic literature reviews to provide a rigorous and transparent methodology for synthesizing evidence from multiple studies, enabling researchers to draw meaningful conclusions and identify gaps in current knowledge (Berssanette and De Francisco, 2021). Implications of this review concern

the ongoing development of flexible, efficient strategies for skill enhancement throughout the entire creative crowdsourcing process (Hotaling and Bagrow, 2020).

### ***Crowdsourcing and skill development***

Brabham (2013) indicates that to deal with creative problems, crowdsourcing is an indispensable method that brings together the shared expertise and different perspectives of team members. Research results show that this approach is successful across a range of contexts like scientific research, product development, and community development, leading to the creation of new solutions. Organizations can use a variety of inputs from several people to discover a wealth of untapped skills and ideas. Although crowdsourcing has shown its success in generating solutions, there has been a lack of focus on the continuous growth of participant skills within these ecosystems. The standard structure of crowdsourcing ventures, frequently identified by one-time competitions or detached problem-solving events, inherently limits the potential for participants to expand on their experiences and cultivate new skills (Boudreau and Lakhani, 2013). This short-lived method does not maximize the chances for long-term skill growth and knowledge development among the participants.

Recent research has shed light on a critical issue within crowdsourcing communities: the absence of well-organized mechanisms for skill transfer. The presence of this deficit has been tied to decreasing participation commitment and increasing employee turnover. When participants realize that the work they contribute to crowdsourcing does not improve their professional or personal development, their motivation to stay engaged will probably reduce. This tendency creates a considerable obstacle to the sustainability and effectiveness of crowdsourcing projects. The opportunity to build deliberate skill development pathways within crowdsourcing platforms is being overlooked. There is a substantial prospect for exchanging ideas and talents when individuals from various backgrounds, talents, and competencies come together on these platforms. When this skill is not backed up appropriately, it holds the potential to reduce the long-term capabilities of crowdsourcing to innovate and manage challenges. In addition, the swift development in innovative and technological realms draws attention to the substantial significance of continual skill improvement and knowledge renewal. Crowdsourcing platforms that cannot support or encourage this ongoing development may have trouble bringing in and keeping top-tier participants over the long term. This might result in a steady falloff in the quality and relevance of solutions produced by these platforms. Crowdsourcing illustrates the critical nature of strategies concentrating on ongoing education and skill enhancement. Changing away from only focusing on solution-oriented crowdsourcing into a more inclusive model that supports participant development might yield multiple benefits. These areas will foster your skill advancement, improve your analytical skills, and improve your job prospects. Crowdsourcing by businesses may lead to more enthusiastic, committed, and skilful member teams who can tackle more challenging tasks as time progresses.

Several forms of skill development can be put into practice by crowdsourcing platforms. Various strategies can be employed, including existing feedback channels, mentoring programs, cooperative learning initiatives, and assorted types of structured training opportunities presented on the platform. The major role is establishing a context that stimulates engagement with current issues while improving personal and professional growth. Placing value on skill development, crowdsourcing platforms have the potential to evolve into important learning environments that draw in a broader

group of individuals seeking problem-solving challenges alongside their growth opportunities. Developing a channel to a richer and more varied community of solvers could create more unique and excellent solutions. Ultimately, crowdsourcing has exposed its skill to motivate new solutions, even though its entire potential is still not fully understood. By looking at the existing obstacles to skill growth among participants, crowdsourcing platforms can develop into more sustainable, engaging, and efficient ecosystems. This change helps individual participants and improves the value proposition of crowdsourcing as a means for innovation and problem-solving in our ever more complex and interconnected world.

### ***Asynchronous learning in virtual communities***

Asynchronous learning models have been extensively discussed, especially in online learning environments where learners interact with material and other learners independently of time and place. These models include flexibility and differentiation learning to enhance learners' continuity in learning, which is important in decentralized contexts such as crowdsourcing communities. The flexibility that asynchronous learning processes bring to the table means that the various elements of a learning process can be accessed and contributed to at the discretion of the subject matter experts involved, thus retaining the independence of learning. This implementation strategy has been most useful in the diverse learner cohort: learners with different time zones, working schedules, or other engagements that can limit their time for learning activities. However, as mentioned above, although there is much literature on the use of asynchronous learning in a formal education context, there is little understanding of how such an approach might work in crowdsourcing, especially in developing creative problem solvers. The nature of crowdsourcing means it is located within a platform where individuals work collectively in large groups across geographical distances. This aspect offers specific insights and poses several issues concerning asynchronous learning. The potential advantages mentioned are improved attendance, various opinions, and a way to mobilize group ingenuity regardless of time and space constraints. Asynchronous learning approaches in online communities show promise for knowledge sharing, yet there remains limited understanding of effectively implementing these methods in open collaboration environments. This gap raises important questions about designing systems that sustain engagement and participation when interactions occur outside of real-time. Key challenges include motivating contributors in non-synchronous settings and developing alternative strategies for peer-to-peer learning and feedback when continuous dialogue is impossible. Additionally, crowdsourcing settings should be considered when implementing asynchronous learning models and the factors associated with enabling creativity and solving problems in decentralized augmented working environments. These span forecasting ways to stimulate creative player thinking, ways to structure the idea-generating processes, and ways of choosing participants so that they can benefit from other participants' ideas. In subsequent studies, it would be interesting to examine how one can design the interactions asynchronously to ensure creative performance at its best, given that crowdsourcing is inherently scalable.

### ***Computational techniques for asynchronous skill transfer***

Some research has looked at ways of using computational approaches to enable knowledge transfer during creative crowdsourcing contests. Computational approaches are being explored to improve knowledge transfer within these contests. Ye and Jensen (2022) discuss the impact of introducing online communities in crowdsourcing contest platforms, emphasizing the importance of facilitating knowledge exchange among contestants. They said this facilitated the enhancement of the quality of submissions. Oppenlaender et al. (2020) developed a way of approaching creativity and getting a complex creative job done by reducing it into smaller sub-tasks. This scaffold approach allowed participants to improve their skills in the basic parts of the assignment. Some of the related work has been done in identifying and documenting best practices to serve as sources of learning regarding the skills in question. For example, Janssen et al. (2017) clustered top submissions using the technique and exposed the clusters as inspirational models. In a series of ideation contests, they increased the novelty and variety of subsequent entries. Rowe et al. (2017) automatically recommended relevant winning ideas to participants as learning resources. This personalized guidance led to measurable improvements in participant performance over time.

### ***Modeling collaborative learning processes***

Researchers have also described the approach to modeling and supporting learning activities in the context of crowdsourcing communities. In their study that used computational linguistics to identify the correspondences of participants' interactions during collaborative creativity, Riedl et al. (2013). It helps to predict group learning from the models of their communication processes. Other work has used the analysis of knowledge flows to explore how skills transfer in dispersed crowdsourcing communities. For example, Gray et al. (2019) integrated SNA with NLP to map the diffusion of innovative practices among contestants. Several projects have planned the architectures to directly manage the skill sharing. For instance, Keikha et al. (2011) have created specific forums that help recognize expert users and forward the questions to them. They identified this as a better solution quality by enhancing peer coaching learning. Anand and Hota (2020) introduced fun in learning using AI agents that represent the skill level and point to suitable partners. The system promotes willing participation in knowledge-sharing activities.

### ***Promoting participation and motivation over time***

Encouraging ongoing engagement poses challenges in volunteer crowdsourcing communities. Studies indicate that providing development opportunities helps sustain involvement. Lakhani and Wolf (2005) found that contributors are motivated to acquire status and expertise. Systems that map advancement in skill areas can thus promote retention. Rowe et al. (2017) demonstrated a positive correlation between goal-setting instruction and academic engagement, underscoring the necessity of establishing clear objectives for improved outcomes. Other research suggests that rewarding participation in knowledge-sharing activates intrinsic motivations. Blohm et al. (2018) implemented a system where points earned for teaching others unlocked privileges. This incentive scheme produced more frequent peer assistance behaviors. Designing contests to maximize variation also prevents stagnation. Dow et al. (2012) tested competition formats that dynamically adjust the creative requirements. Maintaining an evolving challenge encourages participants to expand their skills over time. This review

synthesized three research areas on facilitating asynchronous skill development in crowdsourcing communities, computational techniques for transfer, modeling collaborative processes, and motivating ongoing participation. Key findings indicate that decomposing complex challenges, highlighting exemplars, mapping dialogues, and incentivizing knowledge sharing can all help participants learn from each other's work. Subsequent studies can expand upon identifying the specific techniques for creating crowdsourcing environments that would foster creativity and expertise in dispersed participants.

### ***Theoretical framework***

The study on techniques for skill transfer in creative crowdsourcing is based on the Social Learning Theory as proposed by Bandura in 1977. According to this seminal framework, learning can occur vicariously by observing and imitating competent models without direct reinforcement. People can witness others' behaviors, adopt cognitive skills, and reproduce actions through modeling. Observational learning is key for acquiring new patterns of behavior (Bandura, 1986). Techniques that provide structured exposure to expert exemplars or demonstrate desirable skills align with Bandura's emphasis on modeled experiences as critical for social learning. This research advances Social Learning Theory in virtual crowdsourcing contexts. Digital platforms can facilitate exposure to peers' creative processes. Techniques such as automated feedback, clustering, exemplary work, and modular scaffolding leverage Bandura's principles to support skill acquisition. The theoretical framework thus underpins the computational methods for asynchronous learning. The aim is to provide robust evidence and strategies for leveraging observational learning to foster skill transfer in crowdsourcing. Integrating Social Learning Theory helps explain how participants gain new skills through indirect interactions. The next theory is the concept of Communities of Practice (CoP) by Etienne Wenger which relates to a group of people that acquire knowledge within a given context of activity. These communities are characterized by three crucial components: Members engage each other in the processes of mutual engagement involving the exchange of information and relationships hence creating a sense of belonging and commitment to the organization's goals and objectives; Joint enterprise, where members are involved in collective participation in a given enterprise or goal, hence giving meaning to their activities; Shared repertoire, this is a process in which over time members develop adopted tools, experiences, stories, and practices that they use in the negotiation of meaning and practice advancement. This framework highlights the fact that learning, as well as the construction of knowledge, is a social activity that takes place in the context of common concern and often interaction in each domain of learning.

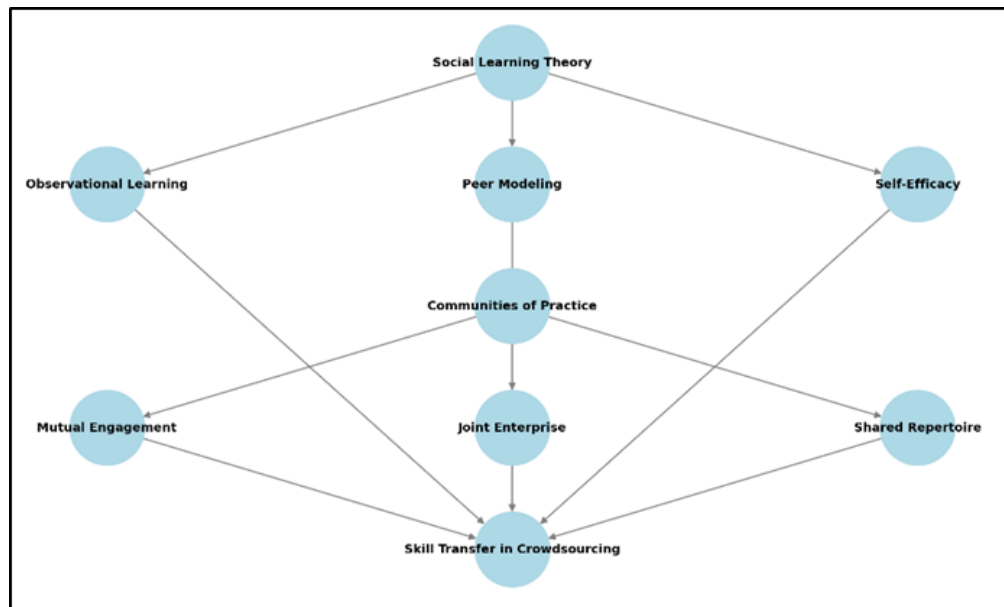
### ***The integration of social learning theory and communities of practice (CoP)***

Integrating Social Learning Theory and CoP explains the factors that could be modified to nurture learning in crowdsourcing environments. Social Learning Theory, as developed by Albert Bandura, entails observation, imitation, and cognitive learning process, which aligns with the functioning of sourcing platforms, whereby people learn from successful projects and contributions made by other professionals. This theory outlines how people acquire knowledge in new settings and can assist in explaining the primary activities of crowdsourcing, namely, observational learning and modeling.

Concurrently, the component of self-efficacy borrowed from Social Learning Theory shows that subjects' perceptions of their competence influence the extent of their engagement and persistence in crowdsourcing tasks. Another concept that can be considered closely related to the ALM concept is Communities of Practice by Wenger (1999), which provides further definitions of how groups of people who are interested in the same problems learn from others during their work practice. This framework is especially relevant to crowd-sourcing sites because the participants usually form communities according to the type of jobs or the field. The three dimensions of CoP, Mutual engagement, Joint enterprise, and Shared repertoire, shed light on how collaboration is sustained and how learning is continuous in these online communities (Wenger, 1999). With the help of these theories, it is possible to comprehend not only the process of learning in crowdsourcing through observation and interaction but also the formation of communities, goals, and practices as continual learning processes occurring in the framework of crowdsourcing platforms. This paradigm combines a solid theoretical framework to support the development and improvement of crowdsourcing settings to facilitate learning, create communities, and engage and enhance participants' performance.

### ***Framework mechanism***

An established conceptual framework bases its functionality on blending Social Learning Theory (SLT) with Communities of Practice (CoP) to help crowdsourcing environments conduct asynchronous skill transfer. The framework acknowledges that learning within decentralized online communities functions beyond individual work because it depends on interactive observational and participatory processes. The core model of modeling learning behaviors is based on Social Learning Theory (SLT) which demonstrates how people learn from Observational Learning and Peer Modeling and Self-Efficacy. The ability to observe allows novice participants to learn from observing experts and experienced members who demonstrate their behaviors and problem-solving approaches. In crowdsourcing platforms with limited real-time mentorship access, presenting high-quality examples to platform participants in structured frameworks becomes essential. The learning process gets strengthened through Peer Modeling, which lets participants interact with each other through observation, followed by skill replication and expert-driven refinement. The motivational factor of Self-Efficacy in SLT functions as a driver by using reinforcement steps that help users develop skill confidence through continuous performance evaluation. People whose achievements get validated by others will naturally demonstrate higher commitment to self-learning activities while continuing their skill development journey. The principles unite to create an active learning space that converts crowdsourcing contributors from content producers into learners who actively refine their skills (*Figure 1*).



**Figure 1.** A conceptual framework for skill transfer in crowdsourcing proposed for this paper.

The Communities of Practice (CoP) framework and skill transfer help crowdsource participants to engage in structured goal-driven environments for collaborative knowledge exchange. Participation under the framework's Mutual Engagement principle allows participants to join actively while exchanging knowledge and resolving complex problems through shared contributions, enhancing learning through community involvement. This alternative crowdsourcing design creates linked task completion instead of single project isolated work because it develops strong community bonds among users. This methodology thus builds continued participation through high user engagement. Through Joint Enterprise, participants dedicate their collective actions to support the main goals of the crowdsourcing community, whether they seek innovation, creative problem-solving, or knowledge co-creation. The third component of CoP, Shared Repertoire, enables the establishment of shared tools and best practices that generate structured knowledge retention. A cyclical process of skill sharing emerges because experienced contributors who enrich the knowledge base deliver structured learning access to new members. These mechanisms produce a self-perpetuating learning environment on crowdsourcing platforms that supports asynchronous learning via theoretical models, peer relationships, and structured community involvement. These collective processes result in successful skill transfer while building long-term knowledge retention and improved user participation, making crowdsourcing serve both task completion and skills acquisition and creative development purposes.

An applied framework exists for actual crowdsourcing platforms integrating skill transfer structures with automated feedback systems, peer mentorship features, and skill-matching technologies. Threadless could implement an AI-enabled mentorship system in its design-based crowdsourcing platform to suggest specific successful designs to new participants for observational learning and peer modeling purposes. The framework enables structured code review processes on Top Coder by allowing expert programmers to give step-by-step feedback to developing participants, thus strengthening their self-efficacy and collective engagement. Members would stay

engaged and maintain their knowledge over time because it uses skill-based badge systems and progression-level advancement features. The proposed hypothetical scenario demonstrates a crowdsourced product innovation challenge that uses Communities of Practice principles to help teams develop concepts while conducting structured practice sharing among members. Platforms that provide continuous embedded mechanisms enable the development of sustainable learning environments that produce enduring expertise across participants and enhance creativity together with engagement and solution quality in crowdsourced work.

## **Conclusion**

The emerging crowdsourcing platform can now efficiently access Creative problem-solving and innovation. The deficient systems of structured skill distribution throughout an asynchronous process prevent the complete potential of participant learning and sustainable engagement. The study initiates knowledge transfer through the conceptual framework that merges Social Learning Theory with Communities of Practice to advance creative skill attainment within crowdsourcing platforms. The framework creates a permanent knowledge-sharing system through which observational learning, peer modeling self-efficacy, mutual engagement, and shared repertoires work together to build a scalable model. By adopting algorithmic feedback functionality and complementary skill groups and designed learning routes crowdsourcing platforms can transition from being basic solution venues into enduring educational environments. This study brings forward new theoretical concepts by combining social learning concepts with digital collaboration platforms and it introduces practical guidelines to develop long-lasting skill acquisition through crowdsourcing models. The study should investigate how to deploy these methods in actual crowdsourcing operations to understand their consequences for user dedication and understanding maintenance along with creative achievement development. The research helps form a better inclusive crowdsourcing future by emphasizing skill sustainability and community-driven learning.

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## **Conflict of interest**

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

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