



Article

Sustainable Education and Open Innovation for Small Industry Sustainability Post COVID-19 Pandemic in Indonesia

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Abstract: COVID-19 severely impacted small industries in Indonesia and many collapsed. Sustainable education is essential to help small industries recover post-pandemic through an open innovation design program to improve small industries' economic, social, and environmental performance. This paper examined the impacts of the sustainable education program implemented and explored open innovations suitable for the sustainability of small industries in developing countries, such as Indonesia, after the pandemic. This research employed a participatory action research (PAR) approach involving academics, government, the community, and four small industries in West Java, Indonesia. Our findings reveal that the sustainable education program through learning activities and direct practice provides valuable knowledge and experience for small industries in designing economic, social, and environmental innovations. Open innovations post-pandemic suitable for small industries in Indonesia include simple business digitalization for company economic growth, the recruitment of people losing their jobs due to the pandemic to achieve social benefits, and innovations in using environmentally friendly packaging and charcoal briquette fuel as an environmental awareness effort. This study recommends that the open innovation designed for small industries be right on target and done using a participatory method to achieve sustainability after the COVID-19 pandemic.

Keywords: open innovation; sustainable education; participatory; small industry sustainability; post COVID-19 pandemic



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1. Introduction

At the end of 2019, the COVID-19 outbreak emerged, which first occurred in Wuhan, China. COVID-19 has spread rapidly to more than 216 countries worldwide, including Indonesia. In Indonesia, the first COVID-19 case was confirmed by President Joko Widodo on 2 March 2020, in Jakarta. As of 20 April 2022, 6.04 million confirmed COVID-19 cases and 156,000 deaths were reported in Indonesia. Indonesia is one of the ASEAN countries most severely affected by the COVID-19 pandemic, with a death toll of nearly 15.6 per 100,000 people as of 28 March 2021 [1].

As a developing country, the number of small industries in Indonesia continues to rise, reaching 62.9 million business units or 99.99% of the total existing businesses. The Regulation of the Minister of Industry of the Republic of Indonesia Number 64 of 2016 defines small industries in Indonesia as industries with a maximum of 19 employees and an investment value of fewer than one billion rupiahs. In Indonesia, small industries play a paramount role and are the foundation of local employment, absorbing 97% of the Indonesian workforce [2]. Many big and labor-intensive companies fail to overcome the pandemic, the risk of collapsing is even higher, and the impact of the pandemic is certainly more severe for small-scale industries.

Research on the impacts of the COVID-19 pandemic on small industries has been widely conducted globally. Shafi [3] found that finance, supply chain disruptions, and the

decrease in demand, sales, and profits are the impacts experienced by small industries in Pakistan due to the COVID-19 pandemic. Most small industries in Pakistan are not ready to handle such situations. Aladejebi [4] revealed that during the pandemic, small industries in Nigeria could not pay loans, rent, and salaries. A survey in the UK in May 2020 showed that 41% of UK small industries had stopped operating, and 35% were struggling to recover. In Germany, 50% of small industries were negatively impacted by the crisis, with a third anticipating more than a 10% decline in revenue. In Italy, more than 70% were directly affected by the crisis. In addition, small industries in other European countries have stated similar concerns [5,6].

Agriculture-based industries in Indonesia experienced a similar circumstance. These industries are vulnerable to the negative effects of COVID-19 due to the limited number of vendors, short delivery times, short product life, and perishability. In Indonesia, small industries faced the following impacts of COVID-19 in the long term: high debt, reduced financial reserves, weakened investment capabilities, disrupted trade, delayed growth and investment, labor problems, and disrupted marketing processes. The social distancing or restrictions imposed reduced the number of visits by consumers who transact with small industries. Undoubtedly, many small industries in Indonesia have slumped due to the COVID-19 pandemic and collapsed due to the losses [7].

The disruption of small industries in Indonesia due to the COVID-19 pandemic occurred for more than two years, and it began to improve gradually in early 2022 when the outbreak subsided slightly. It is undeniable that the COVID-19 pandemic has resulted in fundamental changes in the business environment. This has encouraged various parties at various levels to immediately take measures to survive and recover in this suddenly changing situation [8]. Small industries in Indonesia must slowly start to improve after a long hiatus. However, it is not easy due to some limitations, including finance, labor, infrastructure, networks, and access [9–12].

Following the theme of “a way for universities to be part of the solution”, while there is literature on the contribution of universities to sustainability [13–15], sustainable education implies four descriptors: sustaining, tenable, healthy, and durable [16]. This research highlights the role of universities through sustainable education programs with the aim of helping small industries design open innovations that suit them. Several previous studies have highlighted the linkages between education and innovation, and education is an important component in designing innovation [17–19]. Open Innovation is currently being used as the main strategic approach for small industries to rise after the downturn of the pandemic, while also contributing to sustainable development. This paper focuses on one of the community service projects by academics in West Java, Indonesia, entitled “Workshop Open Innovation for the sustainability of small industries after the pandemic”. The activities were divided into three parts. First was a direct education program providing materials on the open innovation design related to improving economic, social, and environmental performance for small industries after the pandemic. The second was the direct practice program, through various coaching activities and technical practices directly carried out by small industries. Finally, the third is the evaluation of open innovation undertaken by small industries. Various improvements were designed as simply as possible for the small industries to adapt. Open innovation was done gradually by considering the strengths, weaknesses, opportunities, and challenges of small industries. Companies must use external and internal ideas in building the concept of open innovation (OI) [20]. OI combines ideas and contributions from internal and external sources to achieve successful innovation. OI is currently one of the most popular innovation streams [21], along with the increasing complexity of business and the development of communication and information technology that allows a smoother flow of knowledge inside and outside the company [22]. Therefore, the uniqueness and the novelty of this research is that the OI design is carried out in a participatory manner by involving academics, government, and the community, resulting in a more targeted OI.

This study aims to measure the impacts of sustainable education applied and explore open innovations suitable for the sustainability of small industries in developing countries, such as Indonesia, after the pandemic. We believe that by understanding the characteristics and uniqueness and studying the limitations of small industries, we will be able to help them achieve business sustainability after the pandemic. With this approach, we believe this study will contribute to theory development and practical problems. This paper begins with our introduction and research approach, and is followed by a literature review and the method explaining how we obtained and analyzed the data. Our research findings are presented with discussions, followed by research limitations and future research agendas, and then a conclusion.

2. Literature Review

2.1. Sustainable Education Program

University, in particular, creates space for alternative thinking. This is the basis for the concept of the Sustainable Education Program. The Sustainable Education Program is a rapidly emerging field that is guided by a vision of a sustainable society and rooted in a simple truth: we learn what we live. Sustainable Education Program practitioners are trained professionals who understand the challenge of sustainability and who have been prepared to teach others, to catalyze institutional and cultural change, and to model sustainable ways of living [23]. The Sustainable Education Program gives birth to a new ideology of concern, not only for the environment or nature but also for the people around us and our own well-being in terms of quality of life, the way we produce and consume, and how the decisions we make and the activities we take part in affect this. According to the Cloud Institute for Sustainability Education, the Sustainable Education Program is defined as a transformative learning process that equips students, teachers, and school systems with new knowledge and ways of thinking needed to achieve economic prosperity and responsible citizenship while restoring healthy living systems [24].

Sharp [25] published the results of an extensive study involving more than 30 universities. Concerning education strategies, he recommended “face-to-face communication” as the most effective means of sustainable education. Meanwhile, [26] drew a similar conclusion, stating that interpersonal relationships are important in communication, especially to avoid conflicts as they may arise in realizing sustainable education programs [27]. Universities have a significant role in developing the quality of their graduates to benefit society. Wickenberg [28] asserted that “norm support structures,” such as the identification of university leaders with missions or participatory structures or other social areas, are contributing to stabilizing the sustainability process. However, there will be obstacles along the way, such as a lack of awareness, interest, and involvement and groups of people unwilling to share interests with others [29]. Thus, the “human factor” is the most important in achieving sustainable education launched by universities, in addition to complementary factors such as instruments and other communication media. Some other important aspects should also be considered in creating a sustainable education program, including consideration of the plans and actions of others in the field, personal capacity assessment, extensive analysis, collaborative planning, tactics for short-term and long-term projects, and evaluation [30].

Public relations and social marketing highly benefit the frameworks for the management of sustainability education. Therefore, guidelines for sustainability education at universities usually focus on this approach. Interactive processes are an important feature of sustainability communication. In practice, a participatory approach is needed to take advantage of pluralism in knowledge claims, interests, and values in searching, learning, and design. Recent developments in concepts and methods in participatory research provide a useful basis for sustainable education [31].

The main principle of sustainable development emphasizes that the achievement of environmental, social, and economic goals simultaneously must meet the needs of the present generation without endangering future generations [32]. Researchers, as facilitators,

in this activity must find more effective ways to compose and deliver sustainable messages to achieve the main goal of post-pandemic business sustainability. Previous research has demonstrated the need for education reform to ensure long-term success. Projects and interactive approaches are recommended as appropriate learning models to increase participant engagement regarding sustainability issues [33].

In this study, the sustainable education program was realized by two methods. First, the materials related to innovation for small industries are presented directly by academics and equipped with supporting booklets. The second is the direct practice of the designed innovation program; direct practice will help the participants grasp the material and independently implement the programs in the future. Tools, materials, and media for practice must be prepared carefully to support learning. This program is participatory and interactive, so it is hoped that the goals of sustainable education will be achieved as expected [34].

2.2. Open Innovation for Small Industry Sustainability

Open innovation is a holistic approach to innovation management by “systematically encouraging and exploring a wide range of internal and external sources for innovation opportunities, consciously integrating that exploration with firm capabilities and resources, and broadly exploiting those opportunities through multiple channels” [35]. Creative routines and knowledge creation are also important in dynamic open innovation processes. An open innovation process consists of three processes: the outside in, inside-out processes and mixed processes, all of which require the involvement of other stakeholders [36,37].

There are several studies that link sustainable education with innovation. Education plays the role of a key enabler in this process today. In this context, the relevance and utility of advances in information and communication technology (ICT) are boosted. By advancing the argument of the need to conceive education and its role in society in a holistic manner, a case for education as upbringing is made. Against this backdrop, it is argued that the agency of both the learner and the teacher/professor has to be brought back to the analysis if education is to regain its role of the major driver of change and innovation in society, and indeed the key enabler of sustainable inclusive growth [17]. Sustainable education must be structured on the basis of disciplined improvisation, and collaborative knowledge-building activities are required. Creative collaboration in aligned classrooms will generate innovations that matter in today’s economy [18], while other studies reveal that education for mastery of scientific knowledge and methods is absolutely valuable for innovation and growth, but can impede heterodox thinking and imagination [19].

Innovation for sustainability is to gain economic, social, and environmental benefits, a new concept which combines “innovation” and “sustainability”. Formally, innovation for sustainability was defined as the commercial introduction of a new product or service, product service system, or pure service leading to environmental, social—or both—benefits during the previous life cycle [38]. The concept of innovation for sustainability consists of three important components: the level of integration in its implementation (a standing-alone innovation or integrated with others), the renewal in innovation (whether it affects technical updates or, more strategically, the socio-technological component), the impact scope of innovation on consumer behavior and society (how far the innovation will be able to go to solve the problem of sustainability) [21]. Innovation for sustainability in small industries is challenging due to many limitations, including finance, labor, infrastructure, networks, and access [9–12]. However, various studies have also shown that many small industries successfully conducted innovation despite being highly dependent on internal and external factors [39]. Small industry innovation relies on internal sources—both R&D and non-R&D based—and external drivers, such as collaborations with other companies and research centers, and is strongly influenced by location and context [40]. Innovation in small industries is ideally based on science and technology [41].

This research designed an open innovation suitable for small industries. OI is currently the main strategic approach for organizations to contribute to sustainable development [42].

Experts brought up the concept of OI after observing many limitations in implementing traditional innovations. OI has different characteristics from traditional innovation; the flow of knowledge characterizes the innovation process in OI, managed intentionally to pass the organizational boundaries transparently [43]. Open Innovation was manifested in this research through transformative learning, a process in which we shifted the accepted frame of reference and developed beliefs, leading to better actions for the future of small industries [44,45], developing a shared understanding of the need to incorporate education for sustainability, traditional knowledge, and transformative learning to transform knowledge traditions and create meaningful activities. In this case, small industries are encouraged to take positive measures to improve economic, social, and environmental performance, to survive and be sustainable after the pandemic. The OI pillar for the sustainability of small industries focuses on three main objectives. Open Innovations by small industries must improve economic, social, and environmental performance after the COVID-19 pandemic. Due to its participatory nature, the OI design for small industry sustainability was integrated, involving academics, small industry, local government, and the community. Associations or other networks may also be present, considering that networking is important in achieving OI success in small industries [46].

Internal and external characteristics such as a collaborative culture or systems will be required for the success of open innovation dynamics [47,48]. Through alliances, cooperation, and networking will help small industries have access to the downstream market for open innovation [49]. After the success of open innovation in South Korea, it was found that intermediaries such as service providers can help small industries build trust between network members and reduce barriers to innovation [50]. It is also suggested that Policy support can facilitate small industry innovation capabilities [50]. The design of OI is made to be as simple as possible, but still has added value by considering the strengths, weaknesses, opportunities, and challenges faced by each small industry. With its participatory nature, it is hoped that the results of this OI will provide great benefits for all relevant stakeholders.

3. Materials and Method

3.1. Data Collection

This study employed the Participatory Action Research (PAR) method, a dynamic educational method, and a social inquiry approach to overcome various problems [51]. It was applied by exploring the capabilities of the researchers and program participants. As a narrative paradigm, the storytelling technique was used. This research aims to empower small industries to have better economic, social, and environmental performance after the pandemic through open innovation design to achieve business sustainability. The PAR method offers an alternative for knowledge development by bridging the interests of all parties. Case studies were presented and evaluated to create change in achieving goals. Because it is participatory, all opinions from participants were mixed without being manipulated. This method will achieve maximum results if all participants play an active and communicative role in the program. This participatory communication technique was applied mainly in decision-making, benefit assessment, evaluation, and implementation [52].

This research is divided into several stages (Figure 1). First was the selection of small industries to receive an open innovation design. The small industries were chosen by researchers based on the following criteria: those affected by the pandemic, recovered pioneering businesses after the pandemic, and motivated to achieve better performance. The research was conducted in four locations for small industries: Ciamis, Tasikmalaya, Garut, and Sumedang, West Java Province, Indonesia. Four small industries were selected based on the criteria: the cracker industry (traditional food typical of Ciamis made of cassava flour); the *dodol* industry (traditional food typical of Garut, wet cakes made of glutinous rice flour), the wicker industry (the typical Tasikmalaya wicker industry using pandan, bamboo, or mendong as the basic ingredients, the tofu industry (typical food

from Sumedang, usually sold as fried tofu). The second was determining the activity participants, consisting of relevant government officials and the community around the industry. Twenty government officials and local communities were selected at each activity location with sufficient knowledge of small industries, making the total number of participants in the workshop 160. Third, the main data collection was obtained from the activities, workshops, or providing materials in formal classes and hands-on practice classes. The fourth was document analysis and observation, followed by an evaluation of the application of open innovation (Table 1). Evaluation is carried out by conducting interviews and direct observation related to the implementation of open innovation in small industries, analyzing how far the design innovation has been applied to achieve the expected goals.

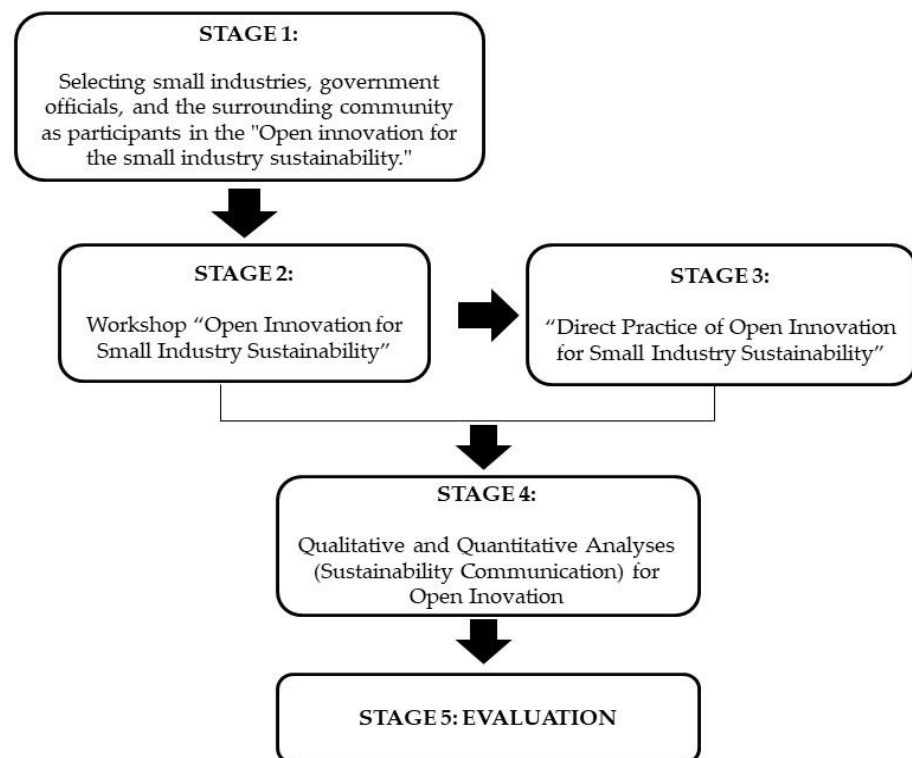


Figure 1. The research design.

3.2. Data Analysis

Descriptive statistics were used to analyze quantitative data using Microsoft Excel to measure: (1) Post-test and Pre-test data related to the understanding of small industries towards open innovation learning; (2) The Impact of Sustainable Education Program: Open Innovation Design. The impact score was obtained from the average of questionnaire results and transformed into a scale of 0 to 1.

Qualitative data consisted of (1) semi-structured questionnaires administered to program participants (related to program benefits, program strengths, and suggestions for improvement for the program); (2) interviews with small industries related to the implementation of open innovations they applied after the pandemic. The data was analyzed and classified by manual coding to obtain keywords. Patterns and correlations between codes were built, followed by first-level categories to divide them into smaller lists of themes. The survey results were compared to the conclusions of the qualitative data analysis, analyzed, and described in detail.

Table 1. The Sustainable Education Program: designing an open innovation program for small industry sustainability.

Program Type	Time	Small Industry	Location (District)
Phase I: Workshop “Open Innovation for Small Industry Sustainability”	2–3 November 2021	Cracker Industry	Ciamis
• Pre-Test	9–10 November 2021	Dodol Industry	Garut
At this stage, practical material was delivered by academics related to planning for improving the performance of small industries after the pandemic and designing open innovations for small industries	16–17 November 2021	Wicker Industry	Tasikmalaya
• Focus Group Discussion and open innovation designed by small industries	23–24 November 2021	Tofu Industry	Sumedang
Phase II: Direct Practice of Open Innovation for Small Industry Sustainability	4–5 November 2021	Cracker Industry	Ciamis
• Hands-on demonstration of open innovation designed by small industries	11–12 November 2021	Dodol Industry	Garut
• Storytelling videos by small industries related to their open innovations	18–19 November 2021	Wicker Industry	Tasikmalaya
• Assessment of video storytelling by academics and participants			
• Qualitative and Quantitative Analysis for Communicative Learning	25–26 November 2021	Tofu Industry	Sumedang
• Administering semi-structured questionnaires for participants			
• Post Test			
Phase III: Evaluation of Open Innovation Implementation in Small Industries	6 March 2022	Cracker Industry	Ciamis
	13 March 2022	Dodol Industry	Garut
• Observation and Interview with informants (Small Industry Actors)	20 March 2022	Wicker Industry	Tasikmalaya
	27 March 2022	Tofu Industry	Sumedang

4. Results

4.1. The Impacts of Sustainable Education Program: Open Innovation Design Learning

4.1.1. Quantitative Data Analysis

Sustainable Education was undertaken to help small industries design open innovations for sustainability. Quantitative data were obtained from the pre-test data, the post test data and data on the impact of the implementation of the program. The pre-test was conducted to examine the level of understanding of small industries related to open innovation before the lessons (Table 2). The questions asked included their understanding of innovation, economic performance, social performance, and environmental performance.

Table 2. Pre-test and post-test results of the small industries regarding open innovation for business sustainability.

Aspect	Material	Pre-Test Results	Post Test Results
Open Innovation	Open innovation for economic performance	0.55	0.70
	Open innovation for social performance	0.68	0.80
	Open innovation for environmental performance	0.60	0.82

The pre-test results showed that the four industries had a similar understanding of the topic, making it easier for the academics to choose materials and learning methods as the participants tended to be uniform. The four small industries scored the lowest in the innovation category for economic performance. They admitted that their limited understanding of economic performance was their main problem. After the workshop, the

post-test showed satisfactory improvement results. Meanwhile, the impact of implementing the sustainable education program is reflected in Table 3.

Table 3. The learning impacts, communication impacts, and participant perception.

Impact	Aspect/Factors	Results
The impacts of the “Open Innovation Workshop and Direct Practice” Learning Program (N = 160)	Awareness and Knowledge regarding the benefits of open innovation post-pandemic	0.75
	Knowledge related to economic, social, and environmental performance	0.70
	The ability to design open innovations for sustainability	0.72
	Practical ability/hands-on practice of open innovation	0.64
The impacts of Sustainable Communication Methods on Small Industries (N = 160)	Creativity	0.70
	Roles of Small Industries	0.72
	Storytelling ability	0.68
Storytelling Impacts (Participants’ Perceptions of the Program) N = 160	Satisfaction	0.84
	Knowledge	0.72
	Skill	0.70
	Awareness	0.70
Storytelling Impact (Participants’ assessment of the small industries) N = 160	Satisfaction	0.76
	Knowledge	0.75
	Skill	0.72
	Awareness	0.78

The impacts of the Sustainable Education Program assessed by the participants were the greatest, especially seen in the aspect of “small industry knowledge related to the benefits of open innovation post-pandemic” (75%). Government officials and the public understand that small industries need open innovation to rise after the pandemic and achieve sustainability. Meanwhile, around 68% of participants stated that the smallest impact was on the hands-on practice ability in designing open innovation. This finding is an evaluation of academics. In the future, more hands-on practice is necessary, so the duration of demos should be longer than the presentation of the materials. The impact of this “open innovation” program was also experienced by the participants in terms of knowledge about economic, social, and environmental performance. Their knowledge was enhanced, and they believed small industries could develop open innovation designs well.

Concerning the impact of sustainable communication methods, 72% of the participants saw it in the active role of small industries. With participatory communication, small industries could play an active role in all phases of the activities. Sustainable communication can also stimulate small industries to be more creative. Small industries felt they had to practice storytelling more often to improve their public speaking skills.

The perception of participants in the program was extraordinary, with 84% claiming to be very satisfied with the program. Participants also considered that the programs provided by academics instilled an awareness of the importance of open innovation for sustainability. Participants also believed that this program increased their knowledge and skills. After the open innovation storytelling video designed by small industries was shown, 76% of participants were satisfied with the results. They also stated that the awareness, knowledge, and skills of small industries related to open innovation increased after the program.

4.1.2. Qualitative Data Analysis

All participants, including government officials and the surrounding community of small industries, provided a good perception of the education and skills of small industries after attending the workshop (Table 4).

Table 4. Direct quotes for “benefits of open innovation workshops and hands-on practices for small industries”.

Respondent	Direct Quotes	Code
Government Officials 1	“This workshop raises awareness in small industries about the importance of economic, social, and environmental performance.”	Awareness
Government Officials 5	“This workshop adds knowledge for small industries related to open innovation.”	Knowledge
Government Officials 15	“This is a valuable experience for small industries, being able to be directly involved in a beneficial program.”	Experience
Government Officials 24	“This workshop increases the skills of small industries, especially in terms of improving economic, social, and environmental performance.”	Skill, Performance
Government Officials 35	“Small industry actors are enthusiastic and fully participate in the workshop; this is very helpful for them after the vacuum due to the pandemic.”	Participation
Public 1	“Live practice is very helpful; small industries can easily absorb the materials.”	Live practice
Public 20	“I saw that small industry actors are very interested in learning.”	Interest in learning.
Public 30	“This workshop opens the small industry’s mindset on the importance of innovation to achieve sustainability.”	Innovation
Public 50	“I saw small industry actors had fun participating in this workshop; I was amazed; they became more creative in creating innovations.”	Fun, Creative
Public 60	“I didn’t expect that small industry actors would be able to do storytelling. This workshop improves their public speaking skills; this is very beneficial for their business.”	Storytelling ability, Public Speaking

The participants believed that this workshop was successful and useful. Table 5 summarizes the keys to this successful workshop based on the participant's points of view.

Table 5. Direct quotes for “key to the success of the workshop program from the participants’ perspective”.

Respondent	Direct Quotes	Code
Government Officials 6	“The strength of this workshop, in our opinion, is in the interesting material; it is also very important for the sustainability of small industries.”	Important and interesting materials
Government Officials 47	“The academic team who provided the material was experienced, friendly and communicative with the participants.”	Experienced and Communicative Facilitators
Government Officials 58	“Because of its participatory nature, this workshop can achieve the expected goals; all parties are engaged in this activity.”	Participative
Government Officials 69	“The facilities, infrastructure, and media support the smooth running of this workshop.”	Infrastructure Support
Government Officials 10	“We have participated in similar events several times, but this one is more meaningful because there were live demonstrations in designing innovations.”	Live demonstration
Public 6	“The workshop is designed simply but right on target; the delivery of the material is easy to understand.”	Simple, targeted, easy to understand
Public 27	“Sustainable communication is the key to the success of this program.”	Sustainable communication
Public 38	“Two-way communication, good interaction, fun.”	Communication and interaction
Public 49	“The purpose of this workshop is very noble, to help small industries return to operation after a vacuum; this is a very useful community service activity.”	Useful community service activities
Public 55	“All communities support this workshop because it is a community service.”	Community support

This workshop program has some limitations in its implementation; suggestions from participants are carefully accommodated for subsequent improvements (Table 6).

Table 6. Direct quotes for “suggestions and improvements for workshop programs”.

Respondent	Direct Quotes	Code
Government Officials 11	“The duration should be longer; it seems extension is better for the workshop.”	Limited time
Government Officials 12	“There are many small industries interested in being analyzed; hopefully, the selection to determine the selected small industries will be better in the future.”	The selection was less transparent.
Government Officials 13	“Too many participants, so noisy”	Too many participants
Government Officials 14	“The proportion of hands-on practice should be increased”	The proportion of practices should be increased
Government Officials 15	“The workshop will be more flexible if it is held on holidays, Saturdays, and Sundays.”	The workshop should be on the weekend
Public 11	“Hopefully, the workshop can be followed up with other important materials.”	The workshop should sustain
Public 12	“The workshop venue is closed to the main road, so our concentration is disturbed due to traffic.”	The venue should be improved
Public 13	“The number of facilitators should be added to make it more interesting.”	Inadequate facilitators
Public 14	“The program socialization is not broad enough; many participants are not informed beforehand.”	The program was not widely socialized.

4.2. Evaluation of Open Innovation for Small Industry Sustainability Post-COVID 19 Pandemic

Evaluation measures were undertaken four months after the program to examine the implementation of open innovation by the four small industries. The open innovation was structured in a participatory manner by considering the strengths, weaknesses, opportunities, and challenges of each small industry. The four small industries applied open innovation to realize post-pandemic business sustainability, focusing on innovation to improve financial, social, and environmental performance (Figure 2).

4.2.1. Open Innovation in Small Wicker Industry

The wicker handicraft industry is one of the oldest small industries in Tasikmalaya, West Java, Indonesia. The local community mostly makes the crafts because the raw material for “mendong” and “panama” is abundant in the area. Tasikmalaya wicker handicrafts usually sold are bags, wallets, tableware, and others. The wicker industry sells its products in its shop in the Rajapolah area, Tasikmalaya. Usually, many wicker handicrafts are bought by tourists visiting Tasikmalaya as typical souvenirs from Tasikmalaya. When the pandemic hit, the wicker industry was almost vacuumed because many tourist attractions in Tasikmalaya were closed to prevent the virus from spreading, reducing the number of tourist visits drastically. This has affected the number of buyers in craft shops for almost two years (from January 2020 to November 2021).

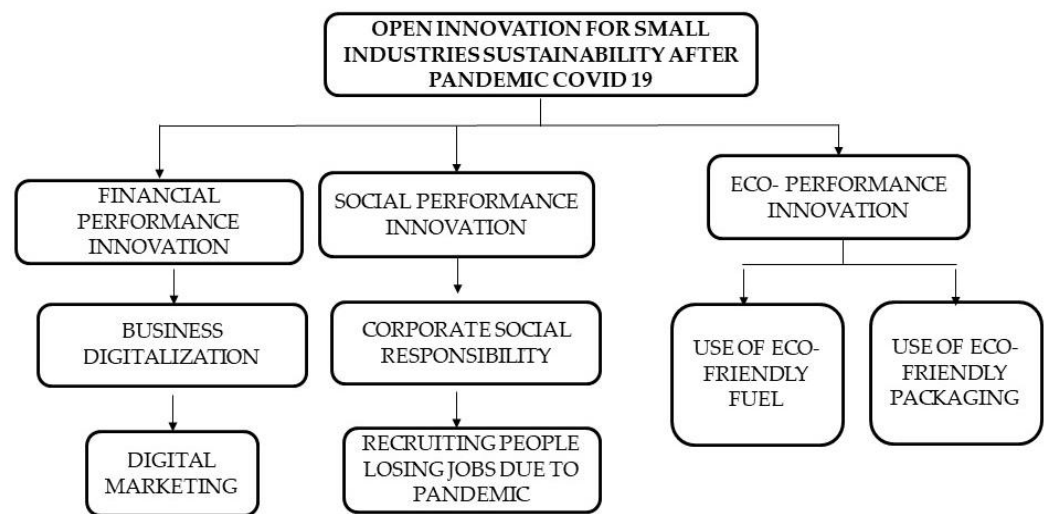


Figure 2. A map of open innovation for small industries sustainability post COVID-19 pandemic.

Open innovation conducted by the wicker industry after the pandemic focuses on improving economic performance due to the poor condition of the economic performance since the COVID-19 pandemic. Following the improvement plan made in a participatory manner in the workshop program, the appropriate open innovation solution is digital marketing. Similar to other types of advertising, digital marketing aims to boost product sales from a brand by utilizing technological advances. Digital marketing is a method preferred by many companies and organizations as technology advances today. The advantages of digital marketing services over conventional marketing methods are the targeted, measurable, and interactive marketing of goods or services.

The digital marketing applied by the wicker industry refers to using digital channels to market products and services to reach wider consumers (Figure 3). The type of marketing used by the wicker industry operates through marketplaces, mobile devices, and social media. Previously, small industries had never tried digital marketing and only relied on direct sales from stores.

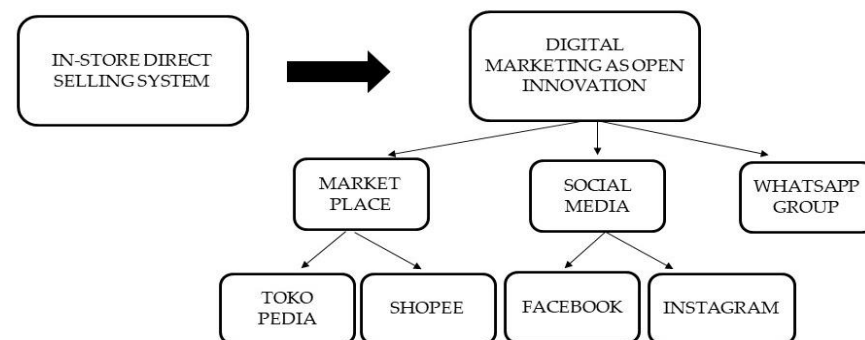


Figure 3. Digital marketing as open innovation in small industries.

Digital marketing involves some common principles as conventional marketing and is often seen as a new way for companies to approach consumers and understand their behavior. To get maximum outcomes, the Tasikmalaya wicker industry combines conventional and digital marketing techniques in its strategy. They began to apply this technique in early December 2021. After five months, this innovation began to provide many benefits for the industry (Table 7).

Table 7. Direct quotes for “digital marketing for economic innovation”.

Respondent	Direct Quotes	Code
Wicker Industry Actors	“Open innovation, digital marketing, that we implement is low cost; I only use my daily internet credit to promote my products.”	Low cost
	“It is amazing; in such a short time, branding can be very fast and broad for my products.”	Fast and broad branding
	“At first, before we joined the workshop, we thought that digital marketing was difficult to apply, but after we learned, it was very easy.”	Easy to used application
	“With digital marketing, it is more effective for us; the ads focus on potential consumers so that they are right on target.”	Targeted customers
	“With digital marketing, we can also collect data on our consumers, which is useful for developing our marketing strategy in the future.”	Collecting consumer’s data

4.2.2. Open Innovation in the Cracker Industry

Crackers are a traditional food from Ciamis District, West Java, Indonesia. Crackers are made of cassava flour mixed with mashed sea fish and other flavoring ingredients. Wet cracker dough is generally formed as oval flowers and sun-dried. When the dough is dry, the crackers are deep-fried until cooked and fluffy. In Indonesia, crackers are commonly used as an additional side dish when having meals. The crackers are distributed by the factory to small shops and sold by traders door to door on motorbikes. Cooked crackers are sold at a very affordable price, around IDR. 5000, -/10 pieces.

The pandemic affected the cracker business due to area restrictions. Many cracker traders could not sell their crackers because many roads were closed to reduce access for unknown people and minimize the spread of COVID-19. However, the demand for crackers remains steady. Compared to the wicker, dodol, and tofu industries, the cracker industry is considered the strongest because crackers are the most common snacks consumed to complement each meal. Indonesians, especially West Java people, have a tradition of having rice, side dishes, and vegetables added with crackers. Therefore, the cracker industry was not severely affected by the COVID-19 pandemic.

After the COVID-19 pandemic, small industries designed open innovation to improve their social performance by recruiting several people who were unemployed due to the pandemic (Figure 4). The impact of the pandemic has brought severe consequences in Indonesia, one of which is increasing the number of jobless people experiencing unilateral termination.

The CSR activity designed by the cracker industry as an open innovation from the company after the COVID-19 pandemic was motivated by normative considerations—the desire to help others. Religion also teaches us to help each other, including when people are experiencing problems, such as losing jobs (Table 8).

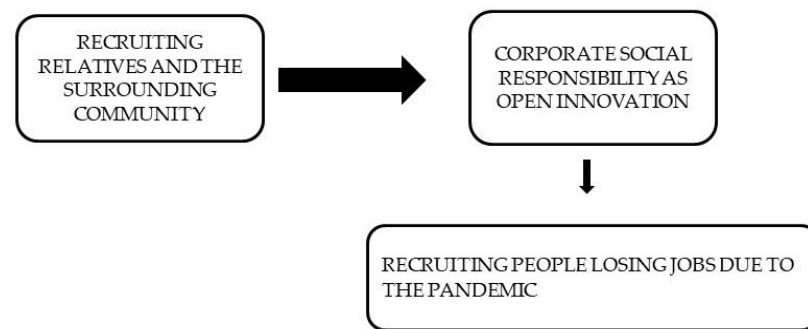


Figure 4. Corporate social responsibility as open innovation in small industries.

Table 8. Direct quotes for “CSR for social innovation”.

Respondent	Direct Quotes	Code
The Cracker Industry Actors	“Our main goal is to help others; we know there are many unemployed due to the pandemic, so we are trying to recruit those who are unemployed due to the pandemic to join our factory.”	Humanitarian Motivation
	“Religion teaches many good deeds. When people are in despair due to losing their job, we should provide benefits to others by creating jobs.”	Providing benefit
	“Even though the situation is difficult, we want to try to help as much as possible. One is recruiting people losing jobs due to the pandemic; we hope this measure will bring us goodness.”	Blessing for everyone

4.2.3. Open Innovation of the Tofu Industry

The tofu industry is the main livelihood of people in the Sumedang district, West Java, Indonesia. Before the COVID-19 pandemic, many tourists visiting the Sumedang district bought tofu. Social restrictions reduced tourists visiting Sumedang drastically and impacted the tofu industry. The tofu was usually a souvenir food that tourists buy when visiting Sumedang.

This condition declined their financial performance. One alternative to open innovation carried out by the tofu industry is to design the use of briquettes as an eco-innovation fuel solution (Figure 5). In addition to being environmentally friendly, these briquettes are more efficient and economical than other fuels, such as LPG. It is also more profitable (Table 9). Briquettes are cube-shaped and sometimes have cavities for easy placement in the stove and packing. The types of briquettes widely used are charcoal briquettes and coconut shell briquettes. This briquette is one of the most popular briquettes for cooking. In addition to the affordable price, cooking using charcoal briquettes is believed to enhance the taste of food.

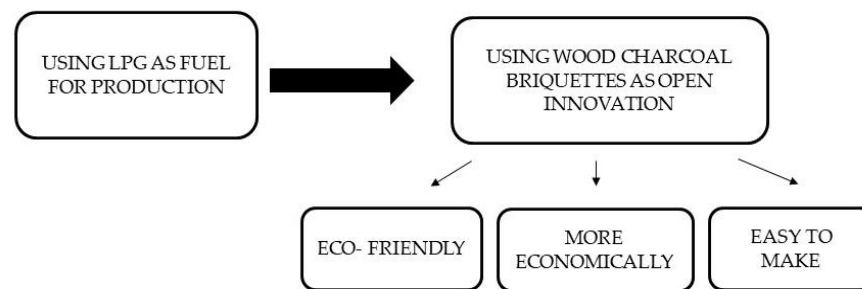


Figure 5. Charcoal briquette fuel as open innovation in the tofu industry.

Table 9. Direct quotes for “charcoal bricket fuel for environmental innovations”.

Respondent	Direct Quotes	Code
The Actors of the Sumedang Tofu Industry	“We switched to charcoal briquettes for fuel because it is cheaper than LPG.”	More economically than LPG
	“The raw materials for making charcoal briquettes: wood and coconut shells are widely available at our place, and the briquettes are very easy to make.”	Briquettes are easy to make
	“Charcoal briquettes are environmentally friendly, and our tofu is more fragrant.”	Environmentally friendly

Charcoal briquettes are easy and simple to make; the harder the wood used, the better the quality. Many tofu industries make their briquettes because it is very simple. It is made of wood processed into sawdust using a wood crusher machine, coconut shell, and starch glue. The stages of making charcoal briquettes are as follows. First, wood is crushed using a wood crusher to create sawdust; the coconut shell is made into charcoal by manual combustion (burned). Second, sifting is done to obtain soft and smooth sawdust and coconut shell charcoal. Sawdust charcoal is sieved through a 50-mesh filter and a 70-mesh filter is used for coconut shell charcoal. Third, the filtered sawdust and coconut shell charcoal are mixed, with a ratio of 90% sawdust charcoal and 10% coconut shell charcoal. Starch glue (2.5%) is added to the mixture when mixing. Finally, the Charcoal briquette is ready to be formed. When the ingredients are mixed evenly, they are put into a briquette machine mold or briquette maker and forged.

4.2.4. Open Innovation of Dodol Industry

“Dodol” is a traditional food from Garut, West Java, Indonesia. It is a wet cake made of glutinous rice flour, with palm sugar as a sweetener and coconut milk for a savory taste. Dodol is usually sold in boxes wrapped in plastic on the outside. This plastic material is impossible to decompose. With the development of technology and industry, more environments are damaged to meet the growing needs. Increasingly severe damage has raised people’s awareness of the importance of protecting the environment. One of the dodol industry’s roles in supporting the improvement of the post-pandemic environment is changing its packaging with eco-friendly products (Figure 6). Eco-friendly packaging is an innovation that helps the environment and brings benefits. Eco-friendly packaging uses decomposable and recyclable materials and does not damage the environment.

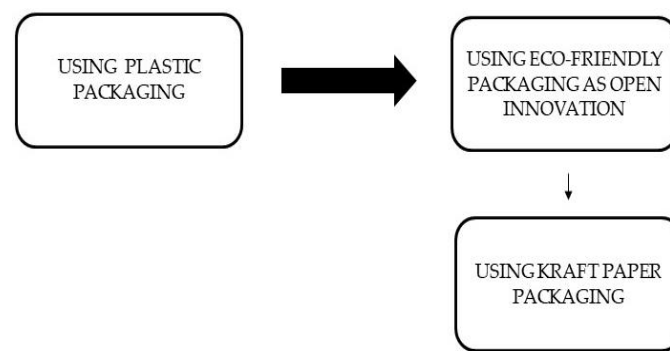


Figure 6. Kraft paper packaging as open innovation in the dodol industry.

The type of eco-friendly packaging used by the dodol industry is kraft paper. Kraft paper is made of pulp or paper pulp from various kinds of wood, including pine resin, which is usually removed when making ordinary paper pulp. All materials used to make kraft paper are reusable, making it more sustainable and environmentally friendly (Table 10).

Table 10. Direct quotes for “kraft paper packaging for environmental innovations”.

Respondent	Direct Quotes	Code
The actors of Garut <i>Dodol</i> Industry	“Using kraft paper instead of plastic as packaging is certainly more environmentally friendly; this is the goal of our open innovation.”	Environmentally Friendly
	“Now, kraft paper is easy to get, so we have no trouble finding environmentally friendly packaging; we have many around us at affordable prices.”	Affordable and easy to find
	“Consumers prefer Kraft paper packaging because it is unique and more beautiful.”	Unique packaging is more favorable to consumers.

5. Discussion

Sustainable Education is a critical effort to build and create understanding, acceptance, and cooperation between various parties [53,54]. Sustainable Education Programs operated by universities are implemented to achieve certain interests, to help maintain or improve the condition of a community [16]. Achieving sustainable education is not easy for universities. Universities must have a strong platform or the basis upon which sustainability plans and programs are based [55]. Universities should see themselves as the most vital links and agents in promoting and advocating sustainability and in making education for sustainability and sustainability education part of their cultures. As micro-societies, they should seek to become true sustainable communities.

In this study, the interest of the Sustainable Education Program is to design the appropriate open innovation while helping small industries improve their economic, social, and environmental performance after the pandemic. This study reinforces previous findings that sustainable education is needed in designing innovation in organizations [17–19]. “Knowledge management capacity” is a dynamic capability, which reconfigures and realigns the knowledge capacities. It refers to a firm’s ability to successfully manage its knowledge base over time. The concept may be regarded as a framework for open innovation, as a complement to absorptive capacity, and as a move towards understanding

dynamic capabilities for managing knowledge [56]. Experiential learning positions learning as a continuous process in which theory and practice are conceptualized and reconceptualized with deep understanding [57]. Academics have provided small industries with knowledge and hands-on practices on how to design innovations, and this approach is considered the most effective in changing behavior [58,59]. After the workshop, the awareness, knowledge, skills, and creativity of small industries in designing open innovation were increased. The key to the success of this experiential learning program lies in the high contribution from all relevant parties (facilitators, companies, government, communities), also supported by interesting materials and excellent facilities and infrastructure.

The design of open innovation was participatory to create open innovations appropriate for small industries. This program involves academics as facilitators and agents of change and small industries as subjects of innovation designers. On the other hand, the government as facilitators and society, as participants in the activity, also act as end consumers of small industrial products. The participatory technique was chosen because it benefits the change process, triggering greater creativity and innovation [60]. With the participatory method, stakeholders also contributed to the decision-making process of small industries in developing open innovation. Hence, the determination of innovation applied was not limited to the decisions of small industry owners but joint decisions involving stakeholders represented by the relevant government, community, and academics. Through the joint decision, the small industries are aware that the right to contribute to decisions affecting one's life is the main principle of human relations as a social being [55]. It is important to note that innovation in the food industry, such as in tofu, crackers, and dodol, is likely to increasingly rely upon the decisions and activities of other entities in the innovation system [60]. This study is in line with the proposition conveyed by Harsanto that companies need to involve external parties in building open innovation [21].

Open innovation designed in a participatory manner by small industries, academics, government, and society aims to improve the economic, social, and environmental performance of small industries after the pandemic [61]. The innovations designed were simple and considered the capacity and capabilities of the small industries, but must be able to create new values, which are generated through the combination market and technology owned by small industries [62]. It should be noted that small industries must also pay attention to the costs incurred for open innovation [63]. In this study, four small industries designed their innovations differently based on their circumstances. The culture for open innovation dynamics can be motivated according to the situation of firms [64]. The wicker industry designed economic innovation through digital marketing as a solution to create a wider market. Products are sold in marketplaces (Tokopedia and Shopee) and social media (Facebook, Instagram, and WhatsApp groups) to improve the company's economy. In the pandemic era, business has indeed experienced significant changes; digital marketing strategies are promising. It helps both parties, both consumers and producers, during the pandemic. Consumers can get the products they want without leaving their houses, while producers can sell their products without consumers have to come directly [65].

Social innovation is an innovation activity undertaken to solve social problems, which has always been the driver of innovation. It focuses on how social and cultural issues affect innovation [66]. The social innovations carried out by the cracker industry in Ciamis, West Java, are based on normative interests [67]. This also confirms that the majority of social initiations carried out by small industries are due to humanitarian considerations [68]. The cracker industry makes social innovations by recruiting many workers who were previously laid off due to the pandemic. The environmental innovations done by the small industries of dodol in Garut and tofu in Sumedang have two basic motives. First, this open innovation arose because of the awareness of the importance of an environmentally friendly culture [68]. Second, open innovation, using charcoal briquettes for production and kraft paper packaging, brings other advantages. They are more affordable so that small industries can save on production costs. Unfortunately, the ineffectiveness of associations and networks in a small industry environment means that there is no collaboration between

small industries and large industries in the development of their open innovations. In fact, collaboration will make open innovation more valuable [69]. Small industries are basically open organizations, which must be involved in a collaborative process of innovation to develop its performance [70].

Limitation and Future Research Agenda

The main limitation of this research study is the relatively small sample size because of the limited data on the number of small industries with a strong motivation to rise and recover after the COVID-19 pandemic. Future research should survey to create a more assertive conclusion based on the hypothetical proposition tested.

6. Conclusions

The sustainable education program through learning activities and direct practice provides valuable knowledge and experience for small industries in improving economic, social, and environmental performance. The awareness, knowledge, skills, and creativity of small industries in designing open innovation were increased. This study recommends that the open innovation designed for small industries be right on target and done using a participatory method. Universities, relevant government officials, and the public as users of small industrial products are external components that can help small industries design innovations to improve their economic, social, and environmental performance post-COVID-19 pandemic. In designing innovations, small industries need to be equipped with knowledge and hands-on practices. They are useful in raising awareness in small industries about the importance of innovation to achieve business sustainability post-pandemic. Sustainable education is the key to the success of the learning program. The Sustainable Education Program must be supported and developed for their abundance of benefits for the community. Innovations designed must always consider the capacity and capabilities of small industries as the subject of innovation. The post-pandemic situation must be considered; motivation and awareness to improve performance are paramount fundamental values that small industries must have to recover after the pandemic. Open innovations suitable for small industries are simpler and more creative, but still have more value and benefit companies, society, and the environment. Post-pandemic, open innovations appropriate in developing countries, such as Indonesia, are as follows. (1) innovation to improve financial performance through digital marketing; (2) social innovation through CSR activities, i.e., the recruitment of unemployed people due to the pandemic; and (3) environmental innovation by implementing environmentally friendly movements in business, such as using environmentally friendly packaging and fuels. Monitoring and evaluation need to be carried out continuously by the government, academics, and the community, so that the performance of small industries will improve post-pandemic and achieve business sustainability.

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