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Innovating Inclusive Entrepreneurship Education: Developing an Ecoprint-Based Instructional Guide for Deaf Students

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Abstract

Entrepreneurship education for deaf learners remains limited due to the scarcity of instructional materials that match their visual learning needs and inclusive pedagogical requirements. Existing resources in Indonesian Special Schools (SLBs) are often generic, text-heavy, and insufficient for supporting hands-on vocational learning. This study aims to address this gap by developing and validating an ecoprint-based instructional guide designed to strengthen entrepreneurial competencies among deaf students. Using a modified Borg and Gall Research and Development model, four stages were implemented: needs analysis, instructional design, prototype development, and expert validation. The resulting guide integrates ecoprint techniques with visually rich, sign-language-supported instructional strategies. Content validation by special education and entrepreneurship experts yielded scores above 90%, while media validation confirmed strong accessibility and visual clarity. Trial implementation indicated notable improvements in students' engagement, independence, creativity, and understanding of entrepreneurial processes. The guide also enhanced teachers' ability to deliver structured, culturally grounded, and sustainable entrepreneurship instruction. This study demonstrates that ecoprint is an effective medium for experiential, inclusive, and environmentally oriented entrepreneurial learning. Future research should explore the guide's long-term impact, its adaptation for students with other disabilities, and its potential integration with digital and community-based entrepreneurship models.

Keywords:
deaf students; ecoprint; entrepreneurship education; inclusive learning; instructional guide development

Abstrak

Pendidikan kewirausahaan bagi siswa tunarungu masih terbatas karena minimnya bahan ajar yang sesuai dengan kebutuhan belajar visual dan pendekatan pedagogi inklusif. Sumber belajar yang tersedia di Sekolah Luar Biasa (SLB) umumnya bersifat umum, berbasis teks, dan belum mendukung pembelajaran vokasional yang bersifat praktik. Penelitian ini bertujuan mengisi kesenjangan tersebut dengan mengembangkan dan memvalidasi panduan pembelajaran berbasis ecoprint untuk meningkatkan kompetensi kewirausahaan siswa tunarungu. Menggunakan model Research and Development (R&D) Borg dan Gall yang dimodifikasi, penelitian ini melibatkan empat tahap utama: analisis kebutuhan, perancangan, pengembangan prototipe, dan validasi ahli. Panduan yang dihasilkan mengintegrasikan teknik ecoprint dengan strategi instruksional visual dan dukungan bahasa isyarat. Validasi isi oleh ahli pendidikan khusus dan kewirausahaan menunjukkan skor di atas 90%, sedangkan validasi media mengonfirmasi keteraksesan dan kejelasan visual yang tinggi. Implementasi uji coba menunjukkan peningkatan keterlibatan,

kemandirian, kreativitas, serta pemahaman siswa terhadap proses kewirausahaan. Temuan ini menunjukkan bahwa ecoprint merupakan media efektif untuk pembelajaran kewirausahaan yang bersifat praktis, inklusif, dan berorientasi lingkungan. Penelitian selanjutnya perlu mengkaji dampak jangka panjang penggunaan panduan ini, adaptasinya bagi jenis disabilitas lain, serta integrasinya dengan model kewirausahaan digital dan berbasis komunitas.

Kata Kunci:
ecoprint, siswa tunarungu; pembelajaran inklusif; pendidikan kewirausahaan; pengembangan panduan pembelajaran

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Introduction

Inclusive education has become a global priority, emphasizing the need to provide equitable access to quality learning opportunities for all learners, including those with disabilities (UNESCO, 2020). Among these groups, deaf and hard-of-hearing (DHH) students often face persistent barriers in mastering vocational and entrepreneurial competencies due to communication limitations, restricted access to instructional resources, and the predominance of verbal or text-based teaching materials (Knoors & Marschark, 2015). In the context of the global shift toward creative and sustainable economic participation, strengthening entrepreneurship skills for DHH learners is essential for enhancing independence, employability, and long-term socio-economic inclusion

In Indonesia, national policies such as the Merdeka Curriculum highlight the importance of creativity, differentiated instruction, and entrepreneurial character building for all learners, including those in Special Schools (SLB). However, entrepreneurship education in SLB remains limited, fragmented, and insufficiently adapted to the visual learning needs of deaf students (Kemendikbudristek, 2022). Teachers frequently report challenges in delivering entrepreneurship concepts due to the absence of contextual, visual, and practice-based instructional tools tailored for DHH learners. Existing materials tend to rely on trial-and-error approaches, resulting in inconsistent learning outcomes and reduced student engagement (Natadjaja et al., 2021).

Entrepreneurship is not merely a business skill but a mindset and a life competence that fosters self-reliance, critical thinking, problem-solving, and innovation(Hou et al., 2022). These attributes are particularly crucial for DHH students, who often encounter socioeconomic limitations after graduation due to restricted employment access (Dube et al., 2021). Therefore, entrepreneurship education must be embedded with accessible and adaptive learning approaches to empower them to create self-employment opportunities.

One promising medium to deliver entrepreneurship education in inclusive settings is through ecoprint. Ecoprint is an environmentally friendly technique that uses natural materials such as leaves and flowers to create textile or paper patterns (Kristanti, 2024). It is a simple, low-cost, and creative technique that can be taught in special education contexts with minimal verbal instruction, making it ideal for deaf students (Rohayani et al., 2025).

Although ecoprint an environmentally friendly technique that uses natural leaves and flowers to create textile patterns holds strong potential as a medium for entrepreneurship learning, especially for visual and kinesthetic learners, its integration into special education remains underdeveloped. Previous studies have explored ecoprint as a creative skill (Rohayani et al., 2025)., yet they have not offered a structured or validated instructional guide specifically aligned with the cognitive, linguistic, and sensory characteristics of deaf students. This gap reveals the need for a pedagogically grounded, visually supported, and culturally relevant instructional resource that connects ecoprint to entrepreneurial learning in SLB settings.

Despite its potential, ecoprint is rarely used in structured entrepreneurship education in SLB environments. This is due to the absence of a standardized, teacher-friendly guidebook that integrates ecoprint with entrepreneurship principles. Teachers often rely on trial-and-error methods, resulting in inconsistent learning outcomes and reduced student engagement (Sonia et al., 2024). This gap presents a critical need for a pedagogical resource that can guide teachers in delivering ecoprint-based entrepreneurship education systematically and adaptively.

Teachers play a central role in shaping students' entrepreneurial competencies. According to the Regulation of the Ministry of Education and Culture No. 15 of 2018, teachers are expected to plan, implement, assess, and guide students in various learning activities including entrepreneurship and vocational training. However, many teachers in SLB are not equipped with sufficient knowledge and pedagogical tools to deliver such content effectively, especially in creative industry-based fields like ecoprint (Zutiasari et al., 2021).

The development of an ecoprint instructional guide specifically designed for SLB teachers can bridge this gap. The guide must not only include technical instructions but also pedagogical strategies tailored for DHH students. It should also be aligned with the cognitive and psychomotor learning domains as outlined by Irvine (2017), ensuring that the learning process is holistic, accessible, and competency-based.

Furthermore, global literature highlights the importance of structured, hands-on, and visually oriented vocational learning for students with disabilities. Research by Lombardi et al (2018) affirms that students with disabilities benefit significantly from individualized, hands-on training that mirrors real-world entrepreneurial experiences. Moreover, teachers who are supported with structured resources report increased confidence and effectiveness in inclusive classrooms (Legodi-rakgalakane & Mokhampanyane, 2022). However, no existing research in Indonesia has developed a comprehensive ecoprint-based guide that incorporates BISINDO (Indonesian Sign Language), step-by-step visual scaffolding, and entrepreneurship competencies aligned with national curriculum goals. Therefore, a clear research gap exists in the design and validation of accessible instructional media that support both inclusive education and sustainable entrepreneurship for deaf learners.

In addition, sustainable entrepreneurship has gained significant attention in recent years, particularly approaches that link ecological awareness with economic empowerment (Bagnoli & Estache, 2022). Ecoprint represents such a convergence providing a platform for environmental stewardship, cultural expression, and economic productivity. Introducing ecoprint into entrepreneurship education for SLB students offers both ecological and socioeconomic value.

The need for this research is further reinforced by the lack of localized teaching materials in Indonesia that connect ecoprint, deaf education, and entrepreneurship. Most existing resources are general in nature and do not address the specific learning needs, communication styles, or psychomotor capacities of DHH students. Therefore, this study aims to fill a significant theoretical and practical void in the literature.

By developing a contextual and validated ecoprint guidebook, this research contributes to inclusive curriculum innovation, strengthens teacher capacity, and enhances the entrepreneurial readiness of deaf students. It also aligns with national educational goals to foster creativity, independence, and sustainability in all school settings, including SLBs. The guidebook developed will serve not only as a teaching tool but also as a model of inclusive and sustainable entrepreneurship education.

Thus, this study is essential to support the transformation of special education in Indonesia. It provides a replicable model for vocational and entrepreneurial learning, contributes to policy recommendations for inclusive education, and empowers deaf students to become creators of value in their communities. In the long term, such initiatives are expected to reduce the economic vulnerability of persons with disabilities and promote their meaningful participation in society.

Methods

This study employed a Research and Development (R&D) approach to design, develop, and validate an instructional guide on ecoprint for teachers in special schools serving students with hearing impairments. As suggested by Sugiyono (2017), R&D is a methodological approach aimed at developing a specific product and testing its feasibility or effectiveness. The model adopted in this study was adapted from Borg and Gall's R&D framework, which is recognized for its systematic steps in educational product development.

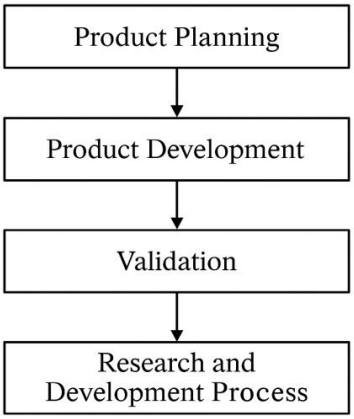
Borg and Gall's full model comprises ten stages, ranging from needs assessment to product dissemination. However, considering the scope and objectives of the present research particularly its focus on inclusivity and practicality in special education the study was limited to four key phases: (1) needs analysis and literature review; (2) planning and prototype design; (3) product development; and (4) expert validation. This simplification is aligned with the recommendations by Borg and Gall (as cited in Judijanto et al., 2024), who suggest that academic-scale R&D projects may focus on a few critical stages due to time and resource limitations.

The research was conducted at SLB (Sekolah Luar Biasa) Tuna Rungu in Medan City, Indonesia, a government-accredited special education institution serving students with hearing impairments. The school was purposefully selected due to its active engagement in life skills and vocational programs, yet it lacked structured instructional materials that integrate eco-friendly practices with entrepreneurship education. The ecoprint guide developed in this study aimed to fill this pedagogical gap by providing teachers with practical and culturally relevant resources.

The subjects of the study consisted of three special education teachers, selected through purposive sampling, who had prior experience teaching craft-based or entrepreneurial subjects. These teachers participated in the product validation process, providing feedback on content clarity, technical feasibility, inclusivity, and

relevance to the students' needs. In addition, two experts in special education and entrepreneurship were consulted to evaluate the alignment of the guide with curriculum goals and inclusive pedagogy principles.

This methodological design ensured that the instructional guide was not only theoretically grounded but also contextually adapted to the specific challenges and opportunities within special education settings. The involvement of field practitioners and experts during the validation process strengthened the practical value of the final product, making it a potentially replicable model for other special schools aiming to promote sustainable entrepreneurship through ecoprint-based education.



Picture 1. Research steps

Result and Discussion

Product Planning

The planning phase in the development of the ecoprint-based instructional guide served as the foundational stage for shaping the content, structure, and instructional goals of the product. This research was conducted in SLB Tunarungu in Medan City, where researchers found that most available materials for entrepreneurship learning were general, text-based, and not tailored to the visual and kinesthetic learning styles of deaf students. Teachers in these schools expressed difficulty in teaching entrepreneurial concepts due to a lack of inclusive, visually-oriented tools (Birinci & Saricoban, 2021).

As a solution, this study proposed the development of a teacher guide that integrates ecoprint a fabric dyeing technique using natural materials like leaves and flowers as a medium to teach entrepreneurship. Ecoprint was selected for its environmental sustainability, cultural familiarity, and hands-on nature, which fits the learning needs of deaf students who rely heavily on visual and tactile input (Wahyuningsih et al., 2024). The process of designing, producing, and marketing ecoprint products naturally aligns with entrepreneurship learning outcomes such as creativity, innovation, and product value creation (Yuliarini & Pamungkas, 2025).

In alignment with Indonesia's Special Education Curriculum (Kurikulum Pendidikan Khusus), the product was designed to support competencies related to creativity, initiative, independence, and collaboration (Kemendikbud, 2018). These competencies reflect the broader national vision of student development outlined in the Profil Pelajar Pancasila, which emphasizes character formation alongside academic learning. By using ecoprint, students are not only trained in vocational skills but are also encouraged to develop ecological awareness and self-reliance.

The guide is highly visual in orientation, incorporating full-color illustrations, pictograms, sign language references (BISINDO), and minimal text. This structure accommodates students' cognitive processing preferences and reduces reliance on verbal instruction, allowing them to engage more independently in the learning process (Knoors & Marschark, 2015). Visual sequences for each stage of the ecoprint process from selecting natural materials to steaming and printing were included to scaffold learning while reinforcing procedural thinking.

In addition to instructional sequences, the guide provides teachers with lesson plans, differentiated learning strategies, classroom material checklists, and rubrics for assessing creativity, teamwork, and product quality. Reflective notes are embedded to support teacher agency in adapting content to local conditions. This dual functionality as a pedagogical and professional tool empowers teachers to design inclusive, context-aware entrepreneurship instruction (Islamudin et al., 2023).

Product Develoved

The product development stage was carried out based on the findings of the needs analysis and curriculum review during the planning phase. At this stage, the instructional guide titled "Creative Entrepreneurship through Ecoprint: A Guide for Deaf Education Teachers" was developed into a functional prototype. The guide was intended not only to facilitate learning activities but also to serve as a transformative tool for inclusive entrepreneurship education tailored to deaf students' strengths and learning styles.

The development process followed a modified Borg & Gall R&D model, reduced to four main steps: (1) needs analysis and literature review, (2) initial product design, (3) expert review and revision, and (4) limited field testing. These steps ensured the product was created systematically while staying feasible under time and resource constraints (Sugiyono, 2017). Content was developed collaboratively with ecoprint practitioners, special education teachers, and curriculum experts to ensure the material was pedagogically appropriate, inclusive, and reflective of real entrepreneurial practice.

The instructional content was divided into five main modules: (1) Introduction to Ecoprint and Natural Dyes, (2) Material Preparation and Safety, (3) Fabric Design and Pattern Making, (4) Production and Finishing, and (5) Marketing and Exhibition. Each module included visual aids, flowcharts, student worksheets, reflective teacher prompts, and assessment rubrics. Instructional sequences were arranged based on visual logic, supporting the visual-spatial cognition of deaf learners (Knoors & Marschark, 2015).

Particular attention was paid to visual clarity and accessibility. Each task was illustrated with full-color photographs and step-by-step diagrams, accompanied by key vocabulary translated into Bahasa Isyarat Indonesia (BISINDO). The use of minimal text was intentional, ensuring that instructions could be followed independently or with minimal teacher guidance. Safety procedures, especially for heating and steaming processes, were clearly explained through icons and illustrated warnings to mitigate risks during ecoprint production (Wahyuningsih et al., 2024).

The physical design of the guide was also optimized for classroom use. It featured A4-sized laminated pages, bound with a spiral ring for easy page turning

during practice sessions. Teachers could use the guide both as a direct instructional tool and a reference for planning differentiated learning. The layout used bold headings, clean spacing, and color-coded instructional blocks to facilitate clarity and ease of use.

Throughout the development stage, regular feedback loops were incorporated. Drafts of the guide were reviewed by three senior special education teachers and two ecoprint instructors. Feedback focused on content coherence, sequencing, and relevance to deaf learners. Revisions were made to enhance logical flow, ensure cultural appropriateness, and simplify technical jargon. As a result, the final product was more aligned with inclusive instructional standards, and better equipped to support entrepreneurship skill development for students with hearing impairments (Birinci & Saricoban, 2021).

Picture 1. Product Develop Ecoprint Guid
Source: Research data, 2025

Product Validation

Product validation is a critical phase in the development of this ecoprint instructional guide. This stage ensures that the content and visual design of the guide meet both pedagogical standards and the learning characteristics of deaf students in Special Education Schools (SLBs). Validation was conducted in March 2025, involving experts in special education, entrepreneurship teachers, and media design professionals experienced in inclusive education materials.

1. Content Validation by Subject Matter Experts

Two content experts participated in the validation: one was a lecturer in special education, and the other an SLB teacher actively involved in entrepreneurship programs. The evaluation focused on aspects such as alignment with learning objectives, accuracy of ecoprint content, and relevance to entrepreneurial character building particularly independence, creativity, and

responsibility. The experts rated the guide highly, with average scores exceeding 90%.

Feedback included suggestions for adding local context, such as using leaves native to the students' surroundings. Additionally, the validators recommended reinforcing reflective activities to help students assess their own progress in creating and marketing ecoprint products. These insights led to revisions that enriched the guide as a tool for developing entrepreneurial competencies.

Table 1. Content Validation Results

Aspect	Indicator	Expert 1 Score	Expert 1 (%)	Expert 2 Score	Expert 2 (%)
Content Accuracy	Alignment with curriculum and learning goals	5	100%	5	100%
	Appropriateness of content for ecoprint media	5	100%	4	80%
	Completeness and depth of content	5	100%	5	100%
Pedagogy	Encourages student motivation and comprehension	5	100%	5	100%
	Suitability for deaf students at the SLB level	5	100%	5	100%
	Content accessibility for different student abilities	4	80%	4	80%
Language Use	Linguistic appropriateness for deaf students	4	80%	4	80%
	Stimulates curiosity and inquiry	5	100%	5	100%
	Accuracy of dialogue and instructional expressions	5	100%	5	100%
Total		**43**	**95.55%**	**42**	**93.33%**

Source: Research data, 2025

2. Media Validation by Design Experts

Two media experts evaluated the design components of the instructional guide, including a visual education designer and an SLB teacher familiar with accessible media. The evaluation emphasized visual appeal, layout balance, text readability, and inclusion of sign language cues. The average score across indicators exceeded 85%, indicating high-quality visual design.

Table 2. Media Validation Results

Aspect	Indicator	Expert 1 Score	Expert 1 (%)	Expert 2 Score	Expert 2 (%)
Visual Design	Overall visual appeal of the guide	4	80%	5	100%
	Accuracy and relevance of illustrations to ecoprint content	4	80%	5	100%
	Color selection enhances comprehension	4	80%	4	80%
	Layout structure and thematic	4	80%	5	100%

consistency				
Total	**16**	**80%**	**19**	**95%**

Source: Research data, 2025

Discussion

The Role of Ecoprint in Supporting Inclusive Entrepreneurship Education

Ecoprint, a natural dyeing technique using leaves, flowers, and other plant parts to create patterns on fabric, is increasingly recognized not only as a sustainable art form but also as an innovative medium in education. In inclusive educational settings, particularly those serving deaf students, ecoprint offers pedagogical and entrepreneurial potential that aligns with their sensory strengths and cultural needs. This section elaborates on how ecoprint contributes to inclusive entrepreneurship education and supports the development of entrepreneurial competencies among students with hearing impairments.

Inclusive entrepreneurship education refers to a learning framework that ensures students with diverse abilities, including those with special needs, acquire the skills, values, and confidence to participate in entrepreneurial activities. The goal is not merely economic empowerment, but also personal independence and social inclusion (OECD, 2019). Deaf students often face communication barriers in traditional learning environments, especially in theoretical, lecture-based instruction. Hence, there is a need for more experiential, hands-on learning models. Ecoprint fulfills this need by promoting visual-tactile learning, which suits the learning modality of deaf students(Birinci & Saricoban, 2021).

The relevance of ecoprint for deaf students lies in its visually rich and sensory-driven process. The ecoprint technique emphasizes the use of natural colors and patterns, allowing students to connect with their surroundings while applying their creativity. Moreover, ecoprint does not rely on verbal communication, making it accessible and effective for students with hearing impairments. As Sonia et al. (2024) noted, the ecoprint process can be adapted into step-by-step visual guides, enabling students to work independently and build confidence in their abilities.

In the context of special education in Indonesia, entrepreneurship education is integrated through vocational and life skills programs, particularly in SLB (Sekolah Luar Biasa). However, the gap between curriculum and implementation remains a challenge. Most programs are either overly theoretical or lack contextual relevance. Ecoprint, on the other hand, incorporates local culture, sustainability, and creativity three components identified by Prastawa & Akhyar (2020) as critical to the success of inclusive entrepreneurship learning.

The integration of ecoprint into entrepreneurial education has also been shown to enhance students' soft skills. According to Islamudin et al. (2023), engaging students in ecoprint projects fosters teamwork, patience, problem-solving, and responsibility. These competencies are integral to entrepreneurship and are particularly important for students with special needs, as they support broader life skills development.

Teachers in the study reported increased student engagement and enthusiasm when ecoprint was introduced. Students were not only active participants but also took initiative in choosing leaves, arranging patterns, and experimenting with techniques. This experiential learning model resonates with Kolb's experiential learning theory, which emphasizes learning through experience, reflection,

conceptualization, and experimentation (Kolb, 2014). Ecoprint offers a complete experiential cycle that is especially beneficial for deaf students who rely more on observation and practical engagement.

Furthermore, ecoprint promotes environmental awareness and appreciation for nature, aligning with the values of Education for Sustainable Development (UNESCO, 2017). Students learn to identify local plants, understand the importance of biodiversity, and value traditional knowledge systems. This ecological aspect adds a layer of depth to the entrepreneurship learning process, making students more conscious of sustainable production and responsible consumption.

Another advantage of ecoprint is its feasibility as a business venture. The production process is relatively low-cost, using easily accessible materials. Finished products such as scarves, tote bags, notebooks, and wall art can be sold in local markets or online, providing real-world entrepreneurial experience. For students in SLB settings, such business ventures can serve as entry points to independent economic activity, reducing dependence on caregivers and promoting inclusion (Arumugam, 2022).

Parents and the school community also play an important role. During project-based learning involving ecoprint, collaboration between students, teachers, and parents created a sense of ownership and shared pride. This echoes the concept of gotong royong (mutual cooperation), a core Indonesian cultural value, which is vital in building inclusive school environments.

From a pedagogical standpoint, ecoprint encourages interdisciplinary teaching. It combines art, biology (plants), chemistry (natural dyes), and entrepreneurship into a cohesive learning experience. This holistic approach enables teachers to meet various learning outcomes while maintaining student interest. For deaf students, this integration fosters a deeper understanding of how different knowledge areas connect in real-world contexts.

In conclusion, the adoption of ecoprint in inclusive entrepreneurship education offers a promising model for bridging the gap between theory and practice, particularly for deaf students. It enhances visual learning, nurtures creativity, promotes sustainability, and fosters economic empowerment. More importantly, it aligns with inclusive education goals by ensuring accessibility and cultural relevance. Future programs should consider scaling up ecoprint initiatives, supported by structured guides and teacher training, to maximize its impact across special education settings.

Development and Validation of the Instructional Guide

The development of an instructional guide tailored to the needs of deaf students in the context of ecoprint-based entrepreneurship learning followed a systematic approach rooted in research and design-based methodology. The process encompassed four major phases: need analysis, design, validation, and revision. This structured model ensured that the resulting guide was both pedagogically sound and practically applicable for special education settings (Plomp, 2013).

The initial phase involved a comprehensive needs assessment conducted through interviews and focus group discussions with special school teachers, curriculum developers, and inclusive education experts. Results highlighted a significant gap in instructional resources that cater to the learning styles of deaf

students, particularly in vocational skills. Teachers emphasized the lack of structured, visual-based teaching materials that align with both the national curriculum and the individual learning needs of students with hearing impairments (Yaakop, 2023).

Based on this input, the design phase focused on constructing a guide that incorporated visual learning tools, simplified step-by-step instructions, pictorial representations, and safety guidance for the ecoprint process. The instructional content was structured into thematic modules covering natural material selection, design planning, eco-dyeing techniques, product finishing, and packaging. Each module included visual prompts, performance checklists, and teacher facilitation tips to enhance student engagement and autonomy (Wahyuningsih et al., 2024).

Validation was conducted through expert review and pilot implementation. Subject matter experts in special education, arts, and entrepreneurship assessed the draft guide for its content accuracy, instructional design quality, and alignment with inclusive pedagogy principles. Feedback led to improvements such as clearer symbol use, adjustment in terminology for accessibility, and the inclusion of differentiated learning strategies for students with varying abilities (Aminda et al., 2023).

The pilot phase took place in a Special School for the Deaf in Medan City, where teachers applied the guide over a 4-week instructional period. Observations, student learning outcomes, and teacher reflections were documented to assess the practicality and effectiveness of the guide. Teachers reported improved student understanding and independence, with notable enthusiasm in executing tasks related to eco-dyeing and product finishing. Moreover, students demonstrated increased initiative in expressing product preferences and participating in group discussions using sign language and visual aids (Wahyuningsih et al., 2024).

The revised version of the instructional guide incorporated the insights gained during the pilot. It included a reflection log section for students, QR codes linked to demonstration videos, and alternative tasks for students needing simpler activities. The final guide emphasized differentiated instruction while maintaining entrepreneurial learning objectives aligned with students' sensory strengths.

In summary, the development and validation of the ecoprint instructional guide represent a critical effort in enhancing accessible vocational learning for deaf students. The approach ensured that the guide was not only content-rich and pedagogically robust but also adaptable to diverse classroom contexts within special education settings in Indonesia. This initiative aligns with the call from international frameworks to develop inclusive teaching resources that bridge the gap between policy and classroom practice (UNESCO,2020; WHO,2021).

Impact on Teachers' Pedagogy and Students' Entrepreneurial Competencies

The implementation of the ecoprint instructional guide had a notable impact on the pedagogical practices of teachers in special schools (SLB), particularly in their approach to teaching entrepreneurial competencies. Prior to the use of the guide, entrepreneurship education in SLB settings often lacked structure and contextual relevance. Teachers struggled to identify pedagogical strategies that could accommodate both the sensory needs of deaf students and the cognitive demands of entrepreneurship. The guide offered a framework that bridged these

gaps by providing concrete, hands-on activities tailored to students' communication and sensory strengths (Kamalia et al., 2023).

One of the most visible pedagogical transformations was the shift from lecture-based instruction to a more experiential learning model. The ecoprint process starting from collecting leaves to fabric dyeing encouraged teachers to integrate project-based learning and place-based learning approaches. These methods fostered deeper student engagement by linking entrepreneurial knowledge with real-life, tactile experiences. Teachers reported that students demonstrated increased curiosity, initiative, and participation during lessons that incorporated ecoprint activities (Sebele et al., 2024).

Moreover, the guide enhanced teachers' capacity to differentiate instruction. Deaf students benefit significantly from visual-based and hands-on pedagogies, and ecoprint inherently provides such modalities. Teachers adapted the steps within the guide using sign language, visual cues, and demonstrations, allowing students to fully grasp both the aesthetic and business aspects of the production process. This adaptation not only facilitated comprehension but also fostered autonomy and confidence among the learners (Krüger & David, 2020).

The introduction of entrepreneurship through ecoprint also reshaped how teachers perceived the economic potential of their students. Traditionally, teachers in SLB settings often underestimated the ability of students with hearing impairments to engage in productive economic activities. However, after witnessing students create, package, and even sell their ecoprint products during exhibitions, many teachers began to revise their assumptions. This attitudinal shift played a crucial role in embedding entrepreneurial mindsets within school culture (Chalise, 2024).

On the students' side, the guide contributed to measurable growth in entrepreneurial competencies such as creativity, initiative, responsibility, and perseverance. These competencies were not only reflected in classroom performance but also during school-led markets and community events. Students exhibited pride in their creations and were able to communicate the value of their products using sign language and digital media, thereby demonstrating both business acumen and adaptive communication strategies (UNESCO, 2022).

Furthermore, students with hearing impairments showed increased motivation to explore other forms of creative entrepreneurship. Some began developing ideas for eco-friendly packaging, branding, and even digital sales through social media platforms managed with parental or teacher support. This expansion of interest demonstrated that the ecoprint initiative had become a catalyst for broader entrepreneurial thinking, even within the constraints of special education (Poed et al., 2022).

In terms of social-emotional development, students engaged in ecoprint projects developed improved collaboration and leadership skills. The structured teamwork involved in gathering materials, producing goods, and organizing school exhibitions provided a platform for students to practice communication, responsibility-sharing, and mutual support essential components of entrepreneurial ecosystems (Hariyanto et al., 2023). These competencies were especially vital in the context of inclusive education, where fostering interdependence among learners is as critical as promoting independence.

The role of character education also gained prominence through this program. Teachers observed that the values of discipline, environmental awareness, and empathy were naturally embedded into the ecoprint project. The repetitive, careful process of leaf collection and dyeing instilled patience and discipline, while the act of using natural dyes promoted environmental stewardship. These soft skills aligned closely with the national character-building agenda, especially in relation to Pancasila values (Nucci & Ilten-Gee, 2021; Kemendikbudristek, 2022).

In summary, the ecoprint instructional guide not only provided pedagogical innovation for teachers but also opened avenues for students with hearing impairments to experience meaningful entrepreneurial learning. By blending ecological awareness, local culture, and practical entrepreneurship, the guide proved to be a powerful tool for inclusive and transformative education. The findings reinforce the significance of developing contextually appropriate, visually engaging, and skill-oriented materials for special education settings.

Conclusion

This study concludes that the ecoprint-based instructional guide successfully addresses the need for accessible, visually oriented, and contextually relevant entrepreneurship learning for deaf students. The guide's integration of ecoprint techniques, BISINDO-supported instructions, and visual scaffolding resulted in strong validation scores and meaningful improvements in student engagement, creativity, independence, and vocational readiness. The findings demonstrate that ecoprint is an effective medium for inclusive, experiential, and sustainable entrepreneurship education, while also enhancing teachers' capacity to deliver structured and culturally grounded instruction in Special Schools (SLBs).

Despite these contributions, the study was limited to one school, a small number of teacher participants, and a short implementation period, which may constrain the generalizability of the results. Future research should examine the long-term impact of the guide on students' entrepreneurial pathways, expand implementation across diverse regions and disability groups, and explore digital or hybrid versions of ecoprint-based instructional media. Such efforts will strengthen the scalability, adaptability, and sustainability of inclusive entrepreneurship education in broader special education contexts.

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