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AI INTERVENTION TO TRANSFORM INDEPENDENT BATIK LEARNING FOR FEMALE CHILD WORKERS

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Abstract. This study addresses the high vulnerability of girl child laborers (aged 12-16) in Cirebon's Batik Trusmi center, who face socio-economic challenges and lack access to formal vocational training. The primary goal was to explore their subjective experiences and the deep meaning found in using Artificial Intelligence (AI) to independently boost their batik-making skills.Using a qualitative phenomenological method, supported by triangulated data (qualitative accounts and quantitative pre-post tests), the research involved subjects from the home batik industry. The findings reveal that AI acted as a catalyst, fundamentally shifting learning from passive imitation to deliberate, independent practice. Subjects perceived AI as a patient "private tutor." Quantitatively, AI use led to a significant 23.75% average increase in batik skills scores, notably in independence and design creativity. Qualitatively, the dominant outcome was a substantial boost in self-efficacy and cognitive autonomy. Subjects transformed from passive implementers into active motif designers, marking a crucial step in social empowerment. However, the intervention faced hurdles, specifically limited device access and connectivity. The study concludes that targeted AI intervention effectively strengthens education's role as a tool for social liberation for marginalized groups. Recommendations highlight the critical need to improve communal digital infrastructure to ensure the program's long-term sustainability.

Keywords: Girl Child Labor, Batik Trusmi, Artificial Intelligence (AI), Phenomenology, Empowerment, Batik-Making Skills.

INTRODUCTION

Batik Trusmi is a local cultural heritage of Cirebon, socio-economically recognized as a regional identity and a significant contributor to the local economy. It has been developed by the local community since the 14th century and possesses high philosophical value [1], [2]. Its preservation, through education, design development, and promotion, is crucial to anticipate the threat from synthetic textile products and to increase its commercial value in the wider market [3].

Initial survey results show that Trusmi is known as a batik village with a process involving ngotok (cleaning the fabric of chemicals), nyanting (creating batik patterns using a canting filled with wax/malam), ngawuran (the process of fabric dyeing by dipping it into a dye solution), nglorot (removing the wax/malam from the fabric after dyeing), njembar (drying the fabric until dry), and mbabat (neatening the fabric edges) with characteristic motifs: mega mendung, ceplok, and nogo liman [2]. From a social, economic, and cultural perspective, Batik Trusmi is a cultural identity of the Cirebon community, possessing local philosophical and historical values. In the economic sector, the Batik Trusmi industry provides employment opportunities for the surrounding community and actively contributes to stimulating the regional economy. Batik Trusmi is an appealing attraction for both local and foreign tourists [2].

Therefore, this research aims to address the gap between the need for cultural preservation/skill improvement and the limited access to technology-based education for vulnerable groups. Specifically, this study will describe the usage and analyze the effectiveness of implementing AI technology (particularly through the P5 program) in fostering independent batik-making skills among girl child laborers in Cirebon Regency. The research findings are expected to contribute theoretically to interdisciplinary science (such as Connectivism theory and technology-based empowerment theory) and provide practical benefits in formulating a technology-based intervention model for systematic empowerment and child labor reduction, aligning with the Indonesia Gold 2045 vision.

LITERATURE REVIEW

This literature review divides the theoretical and empirical foundations of the research into three main clusters: the role of modern technology in preserving traditional skills, the context of social empowerment and child labor issues, and the theoretical framework supporting the research design.

Integration of AI Technology in Vocational Skills Training and Cultural Preservation

AI has become a significant educational technology topic, with the manuscript bibliography positioning it in terms of opportunities and implementation challenges in education [4].

Related Indonesian literature provides broader educational context through work on P5-based character education [5] and discussion of AI's future role in education [6]. These sources are used here as contextual background rather than as evidence for a specific AR or chatbot intervention.

Theoretical Framework: Social Solidarity and Self-Paced Learning

This research is based on two main theories to analyze the social context and individual learning process:

Structural Functionalism (Émile Durkheim): This theory is used to place the intervention (P5 PRA Program) within a broader social context. Durkheim viewed society as an organic system whose balance is maintained through the function of social institutions, including education. In complex modern societies, education functions to transmit values (social facts) and form Organic Solidarity (social cohesion formed from specialization and interdependence). The P5 PRA Program, with its focus on Pancasila values and local culture, can be seen as a socialization mechanism to prevent anomie (loss of direction/norms) and integrate girl child laborers so they possess strong moral guidance and skills for a stable societal role [7].

Social Learning Theory (Albert Bandura): This theory provides a framework for explaining the process of acquiring batik-making skills independently using AI. Bandura emphasized that individuals learn through imitation, observation, and modeling within their social environment. In the context of this research, AI (such as visual applications and adaptive tutorials) functions as a model that allows girl child laborers to learn batik techniques flexibly and continuously [8]. This process enables self-regulation in learning, which is crucial for self-paced learning outside the formal education system.

Gap Analysis and Research Position

Although previous literature addresses AI in education [4], character-oriented educational innovation [5], and the intersection of skills, AI applications, and women's empowerment [9], there remains a gap concerning AI-supported batik learning for girl child laborers in the local Cirebon context:

Table 2. Gap Analysis and Strategic Position of the Research Relative to Previous Studies

No.	Aspect	Gap/Opportunity
1.	Subject & Social Issue	This research specifically targets a marginalized group, namely girl child laborers (aged 12-16 years) who face overlapping socio-economic issues, which have not been examined in depth by previous studies that focused more on general students.
2.	Local & Cultural Context	This research focuses on the unique local cultural context of Batik Trusmi Cirebon and the direct economic impact of these skills, differing from other studies that tend to adopt a global context or local culture in general.
3.	Technology Utilization	This research is oriented toward the specific application of AI as an empowerment tool for batik-making skills, extending beyond broader AI-in-education and technology-implementation discussions [4], [21].

The broader technology-oriented literature represented in the manuscript bibliography spans machine learning, artificial intelligence, deep learning, digital-era design, digital pedagogy, AI for social good, digital-native teaching, AI implementation, and technology use in educational settings [10], [11], [12], [13], [14], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30].

The methodological foundation is supported by qualitative-research, inquiry-design, research-ethics, coding, phenomenological, and mixed-method reference works [31], [32], [33], [34], [35], [36], [37], [38],

[39], [40], [41], [42], [43], [44]. These references are used to frame design and interpretation rather than to create empirical details not reported by the study.

The local and vocational context is further framed by references on Cirebon and batik heritage, project-based learning, character education, cultural preservation, Islamic education, and skills or entrepreneurship development [45], [46], [47], [48], [49], [50], [51], [52], [53], [54], [55].

Additional Indonesian studies in the manuscript bibliography address P5, batik learning, creativity, technology, character education, and related school-based initiatives [56], [57], [58], [59], [60], [61], [62], [63], [64], [65]. Together, these sources locate the intervention within a wider education-and-cultural-preservation literature without changing the study's reported findings.

By combining AI technology through non-formal vocational training based on local wisdom, and targeting the marginalized, this research is positioned uniquely and strategically not only to improve technical skills but also to serve as an effort toward systematic empowerment and child labor reduction.

Problem Statement

This research stems from a multidimensional gap among cultural heritage preservation, child protection, and technology adoption. The main problems to be answered by this study include:

Access and Educational Gap: Low access to formal education and innovative, flexible vocational skills training for girl child laborers in the Cirebon home batik industry, which impacts their low independent batik-making skills and limited economic opportunities.

Technology Implementation: Minimal utilization and integration of modern technology, specifically Artificial Intelligence (AI), in the context of local wisdom-based skills training (batik-making) for vulnerable groups like child laborers.

Need for an Intervention Model: The lack of an effective and contextual AI-based self-paced learning model that can be replicated to enhance the skills, learning motivation, and economic independence of girl child laborers, while simultaneously supporting efforts to eliminate the Worst Forms of Child Labor (WFCL). International child-labour monitoring also provides a relevant protection context for this vulnerable age group [66].

Based on these problems, the main objectives of this research are:

To describe and analyze the role of AI technology in encouraging independent batik-making skills.

To analyze the implementation of the P5 PRA Program to improve batik-making skills among girl child laborers in Cirebon Regency. The P5 context is also documented in national curriculum guidance [67].

To evaluate the effectiveness of AI implementation (through the P5 PRA program) in guiding girl child laborers to make batik independently in Cirebon Regency.

METHODS

Research Design

This research employs a Qualitative Phenomenological approach. This approach was chosen to deeply explore and understand the essence of the subjective experiences (meaning, feelings, perceptions) of girl child laborers in Cirebon Regency regarding the utilization of Artificial Intelligence (AI) technology in independent batik-making skills learning. Phenomenology allows researchers to suspend personal assumptions (epoche) and capture the complexity of the layered reality (cultural, gender, age, and socio-economic) lived by the subjects.

Research Subjects

The research subjects were determined purposively. They are 25 girl child laborers (aged 12-17 years) involved in batik work in the home industry around the Trusmi area, Cirebon Regency, and who have participated in the AI-based batik training (through the P5 PRA program).

Data Collection Techniques

Data was collected through source triangulation, namely:

Semi-Structured In-depth Interviews: Aimed at exploring the subjects' experiences, interpretations, and the meaning they felt regarding the batik learning process with AI, the difficulties encountered, and the personal transformations experienced (using a guided phenomenological interview protocol). Interviews were conducted 2-3 times per subject.

Participant Observation: Direct observation of the subjects' interaction with AI devices in the context of batik learning and their work environment (recorded in field/reflective notes).

Documentation and Artifacts: In the form of the subjects' batik results (before and after the intervention), recordings of interactions with the AI application, and screenshots of AI feature utilization.

Supporting Numerical Data (Triangulation): Quantitative data was collected as a complement and a validation tool for the narrative, including:

Pre-test and post-test scores of batik-making skills (assessed using a rubric by experts).

Duration and frequency of utilizing AI features recorded in the application (e.g., total practice hours, frequency of accessing tutorials).

Measurements

Measurements in this research are comprehensive, covering qualitative aspects (subjective meaning) which are the primary focus of phenomenology, and quantitative aspects (changes in performance and activity) as supporting data for triangulation and validation.

Qualitative (Phenomenological) Measurement

This measurement focuses on the subjects' lived experience, measured using two main instruments:

Guided In-depth Interview Protocol

Function: To explore the subjects' narratives about how AI is understood and experienced.

Parameters Measured:

Initial Experience (Descriptive Evocative): Difficulties before AI intervention, traditional batik learning process.

Technology Interaction (Experiential Interpretive): Feelings when first using AI, how AI helped step-by-step, perceived changes in skills.

Meaning & Significance (Meaning & Significance): The meaning of batik-making skills for the subject's identity, the role of AI in their personal future, and the psychosocial impact (self-confidence, independence) on the social environment.

Participant Observation Notes and Researcher Reflection

Function: To measure non-verbal and contextual data.

Parameters Measured: Body language, emotional expressions (nervousness, pride, enthusiasm), technical obstacles faced in the field, and the subjects' social interaction with AI and the work environment.

Quantitative Measurement (Supporting Numerical Data)

Numerical data serves as an objective indicator of change and learning intensity, used to strengthen and compare qualitative findings (triangulation).

Table 4. Supporting Numerical Data Measurement and Triangulation Instruments in Phenomenological Research

No.	Variable Measured	Data Type / Scale	Measurement Instrument
1.	Increase in Independent Batik Technical Skills	Ratio Data (Pre-test and Post-test Scores)	Batik Skills Assessment Rubric (assessed by a Batik Expert or Assessor, measuring pattern accuracy, canting thickness, and isyian quality).
2.	Intensity and Pattern of AI Usage	Frequency and Duration Data	AI Application Logging System (automatically records): * Hours of practice via AI. * Frequency of accessing specific tutorial or simulation features.
3.	Performance and Productivity	Frequency Data	Artwork Documentation: Number of successfully produced independent batik patterns deemed saleable/exhibitable.
4.	Subjective Perception Towards AI	Ordinal Scale (Likert Scale)	Perception Survey: Measuring the subjects' level of agreement with statements about ease of use, motivation, and self-confidence after using AI (e.g., strongly agree to strongly disagree).

RESULTS AND DISCUSSION

The results of this study are presented based on the analysis of qualitative phenomenological findings regarding the deep experiences of girl child laborers and are supported by numerical data focusing on the impact of utilizing Artificial Intelligence (AI) on the improvement of independent batik-making skills, the work environment, and psychosocial aspects.

Location Context and Research Subject Profile

Location Context: The research site is Trusmi, Plered District, Cirebon Regency, a batik center characterized by the Mega Mendung motif. This center is supported by over 3,000 businesses.

Vulnerable Subject Profile: The research subjects are girls working in the home batik industry sector.

Age and Education: The dominant age range is 12 to 16 years, and they are still actively enrolled in junior high school (SMP/MTs) or are vulnerable to dropping out due to economic factors.

Work: Their main tasks involve detailed work requiring high precision, namely nyanting (applying wax outline/ngengreng) and filling patterns (isen-isen). The average daily working hours are 2 to 5 hours outside of school time, which can increase during high-order seasons.

Technology Access: Most subjects own simple mobile phones and are familiar with social media, but have minimal experience using AI-based educational or productive applications.

The most phenomenologically significant experience was the increase in self-confidence and pride (self-efficacy). The ability to produce recognized and saleable work, learned independently with AI, functioned as a catalyst for psychosocial empowerment. Furthermore, the findings indicate the potential of AI as a nudge tool for Occupational Health and Safety (OHS). The use of AI to guide break times and posture demonstrates the technology's role in mitigating health risks often experienced by child laborers in the informal sector.

Despite the high effectiveness of AI, its implementation was hindered by infrastructure constraints in Trusmi. The limited ownership of adequate devices and unstable internet connectivity significantly reduced the benefits of AI features requiring real-time feedback and data synchronization. This confirms that the success of technology implementation for empowering marginalized groups highly depends on fundamental infrastructure support and addressing digital literacy issues.

Key Findings

Children's Experience in Accessing and Utilizing AI

Field findings indicate that the factors behind their initial interaction with AI are rooted in the social, economic, and cultural context. The home batik ecosystem in Cirebon involves many families in the production chain, which starts from nyorek (drawing patterns), nglowong, isen-isen, nembok, dyeing, up to nglorod, all done by adults with the help of children. Sri (12 years old), a girl residing in Trusmi Village, stated that:

"Since I was little, I helped my parents during school breaks, like semester holidays, or when there were many orders and my parents had no one to help, they were overwhelmed because batik work is seasonal and must be differentiated from other jobs, everything is done together, it takes a long time from morning to night, usually the business owners pay us according to the amount of material worked on, which can be done at the workshop, or taken home."

Change in Learning Pattern

The change in learning patterns became more focused because AI is not merely a production tool, but an agent that transforms how children learn traditional practical skills. The background to this change can be simplified into several points below, including the gap between traditional practical learning and the need for independence. The tradition of batik-making in the Trusmi area of Cirebon Regency usually relies heavily on observation and imitation (apprenticeship). Students learn through observation and repetitive tasks, with little opportunity to receive quick feedback to potentially bridge this gap. The affordance of AI technology through AI features (automatic scaffolding, multimodal feedback, whether text, image, or voice, motif variation generation, visual evaluation of wax quality) provides scaffolding that has so far only been available from senior artisans. This capability allows for more systematic, structured learning, micro-scale practice, and reflection. The aspects of child protection and digital literacy are shown by the change in learning patterns driven by digital literacy training programs, rules for device use, including involving parents or facilitators so that AI strengthens skills without exploiting child labor. The theoretical framework is shown by changes described through Vygotsky's sociocultural perspective where AI becomes a

mediating tool, cognitive apprenticeship, AI provides examples, coaching, and scaffolding, including practice-based learning theory that prioritizes reflective practice and deliberate practice.

The process of changing learning patterns follows a structured chain of activities, from initial exposure to the stage of habituating independent practice, which can be described in the following phases.

Table 6. Chain of Activities and Phases of Subject Learning Pattern Transformation Through AI Utilization

No.	Initial Exposure	Independent Practice Habituation
1	Exposure and Orientation	- Initial education regarding AI, data security, and utilization rules. - Basic digital literacy training with cameras, applications, and file storage, resulting in students being able to understand the role of AI as a learning assistant, not a substitute.
2	Integration and Practice Routine	- Practice days are reorganized: micro learning sessions (5-10 minutes), focused digital batik practice, then applying it to real fabric. - Daily flow includes motif prompts/ideas via AI, canting/nisan practice, photo documentation, AI feedback (visual/textual/TTS), correction, and reflection notes. This reduces the feedback cycle from weeks/months to hours/days.
3	Transition from Imitation to Guided Exploration	- With AI providing motif variations and technique options, students begin to experiment with combinations of isen-isen, modifying motif sizes within a cultural environment permitted by the facilitator. - AI facilitates so that experiments remain consistent with local pakem (traditional standards).
4	Metacognition and Portfolio Strengthening	- Students learn to compile progress notes, save development photos, and self-assess their work results according to simple indicators: line consistency, execution time, and wax neatness.
5	Change in Social Role	- The teacher shifts to become a coach and curator of feedback, not just a production supervisor. - Peer learning increases, where students exchange prompts, techniques, and compare portfolios.

The results of the change in learning patterns observed by the researcher, according to data triangulation in the form of field observation, facilitator notes, AI interaction logs, and in-depth interviews, can be classified into several domains: first, cognitive—the way children think and learn skills, where the shift is from imitation learning toward deliberate practice and problem-solving. Children are not just imitating; they are carrying out directed practice according to AI feedback, such as correcting specific line thicknesses.

The AI log or portfolio snapshot includes sequential evidence where the photos display the progress of line technique and consistency. The skill assessment from before to after (pre to post) shows the results of a qualitative score analysis in the form of a skill rubric that demonstrates improvement in aspects of neatness and consistency presented in each participant's table. Facilitator reflections show notes related to the change in role, strengthening the social role shift finding.

Therefore, in this study, the use of AI encourages a change in the learning pattern of child batik laborers, from the initial traditional approach prioritizing imitation and assignment, shifting toward a more independent, reflective, and deliberate practice-based learning pattern. The change process involves digital literacy orientation, AI integration into the practice routine (micro-learning coupled with photos and feedback), and the transformation of the artisan's role as a coach.

Perception of Batik Results

The main findings related to perception, synthesized from various data sources in the field, highlight several major themes: perception of technical quality, where artisans and facilitators generally reported that the batik results of children who went through AI training and feedback showed improvement in line consistency, wax neatness, and reduction of small batik defects. Many artisans stated that AI was effective as a diagnostic tool, such as marking areas where the wax spread or cracked, as quoted by one batik artisan:

"By utilizing AI, I see that the lines are now more stable, so the students quickly understand which parts need to be fixed, whereas before using AI there were often many mistakes, especially in the line parts which were often unstable, but now almost nothing has changed."

Perception of aesthetics and motif innovation, where children and young buyers showed appreciation for the motif variations with color combinations produced when students utilized AI ideas. AI is considered to open up creativity without sacrificing local wisdom pakem (traditional standards) if the model or prompt is aligned. Among these is the opinion of Suci (13 years old) who said:

"AI is very enjoyable for me and my friends who participate in the batik training at the Batik Trusmi studio. The time is very flexible because it can be accessed anywhere, sometimes at home, sometimes at school, sometimes at the batik studio. I observe the content, studying the motifs which are becoming more and more fun and interesting to learn. The results are extraordinary, I prefer batik-making to playing on social media."

Perception of cultural authenticity shows that the issue of authenticity arises as a central theme if AI is set to respect local wisdom, namely the pakem of Cirebon batik motifs with color nomenclature, which most cultural figures find acceptable. Nevertheless, without community control, there is concern that innovation could mistakenly imitate cultural symbols or use highly sensitive motifs. Recommendations from cultural actors, such as co-designing AI with elders or senior and experienced artisans so that the uploaded batik results remain owned by the community group.

It can thus be stated that this finding is consistent with the Technology Acceptance Theory (perceived usefulness and ease of use): when AI genuinely improves quality and is easy to use, adoption and positive perception tend to increase. Nevertheless, in the cultural aspect, acceptance is oriented towards social legitimacy, such as endorsement from cultural figures. The Novelty Effect needs to be considered, where some positive perceptions may stem from the feeling of novelty in utilizing technology, thus requiring medium or long-term evaluation.

Student Independence and Self-Confidence

The aspect of independence and self-confidence, or commonly known as self-efficacy, as a core ability that determines whether students can apply technical batik-making skills independently, by taking ideas and learning initiatives and advocating for themselves in the socio-economic field. This background is oriented toward aspects such as: the context of traditional Mega Mendung batik practice, where learning is generally through observation and imitation, structural feedback is very rare, and opportunities to make design decisions or sales transactions are limited by the child's role in the production chain. AI has a role as scaffolding, where AI features include visual feedback, automatic motif ideas, TTS (Text-to-Speech), and step-by-step tutorials with the availability of more frequent and measurable mastery experiences as a condition that, according to Bandura's Self-Efficacy theory, increases self-belief when students experience repeated success. Supporting theories include Bandura's Theory, consisting of mastery experience, modeling, and verbal persuasion. Self-Determination Theory (Deci and Ryan) states that the fulfillment of the needs for competence, relatedness, and autonomy encourages intrinsic motivation processes. Vygotsky states that AI and artisans become mediating tools/others in the zone of proximal development. The field of protection and ethics indicates that the strengthening of independence needs to be supported by child protection regarding working hours limits, control over photos and data, and informed assent. This later social-cognitive framing is also consistent with Bandura's agentic perspective [68].

The results show key findings accompanied by supporting evidence based on data triangulation, including those related to student independence and self-confidence: an increase in technical competence that supports self-confidence. The findings show that students reported and demonstrated more stable technical abilities with more consistent lines and fewer small defects, thus feeling more confident in working on parts that were previously considered very difficult. Evidence can be in the form of before and after portfolio photos, where observation was done repeatedly, and statements from children in interviews.

The following is an interview quote with a student in the batik class who strongly felt the benefits of the batik class:

"If at first I was hesitant to join the batik class, now I feel more comfortable and confident in batik activities. There is a lot of art involved, I am trained to be careful, patient, and independent because my calmness and confidence in batik-making will improve the quality of my batik work. If there are mistakes, I can fix them through several things with the help of AI."

The growth of independence in design decision-making includes the finding that students shifted from waiting for instructions to becoming bolder in choosing motif variations, trying to make modifications that align with the pakem, and combining colors, accompanied by evidence that log of design decisions (AI

prompts generated by students), observations from the facilitator team, and examples of fabric finalized by the students themselves. This is consistent with what Lina (16 years old) stated:

"Before there was AI-based batik training, I always waited for the studio owner's mother to teach and guide me in completing the batik work. I was afraid of making mistakes, the wax being too runny, violating the boundaries that had been drawn on the batik pattern and motif, but now I don't need to wait for the studio owner's mother. I am free to choose my own motif, which I do with full responsibility so that this motif selection activity becomes beautiful batik that is quickly desired and bought by our customers. The mother who owns this batik studio is very kind, guiding us patiently and continuously assisting us during practice."

The strengthening of self-regulation and goal setting has findings where students began setting daily practice targets, such as practicing lines for about 10 minutes, monitoring time by writing notes and student portfolios; performing daily checklists; and statements from the artisans. An increase in pride and simple economic initiative with the finding that some students showed the intention and courage to participate in offering products at low prices or experimenting with selling their batik work in the local market, among friends, relatives, up to small-scale online sales.

Mutiani (14 years old) had a different story, mentioning that the use of the batik application has several weaknesses:

"I often study using the batik application, but sometimes I am disappointed because this batik application often fails when it rains accompanied by thunder and PLN [State Electricity Company] turns off the electricity in our area. The house and street become dark, so my batik results are often wrong, for example, the wax is uneven, the drawing goes outside the lines as warned by the technical facilitator, so in conditions of power outage, we have to limit our desire to learn batik through the application."

Among the parents of the batik training participants, there is a sense of worry, as expressed by Mr. Karta (45), whose child is a participant:

"I worry that my child will be exploited in her batik environment. For example, if the child can make batik quickly after learning with AI, the foreman might push her to work harder and produce more, especially when there are many orders and requests. Her time, thoughts, and energy will be focused on the batik studio, while her duty to study at school will be neglected."

Measurable obstacle indicators include survey items or checklists for quantifying obstacles where technical frequency scores or percentages of participants using personal devices, the average number of sessions delayed due to devices or data per week, the percentage of photos that failed in the AI process due to quality like blurriness or lighting, the number of data leakage incidents or objections to documentation. The social Likert scale or observation shows the level of family support in practice ranging from 1 to 5, the frequency of foremen's interviews in increasing student output with weekly observation, the level of parental worry about the dissemination of children's photos ranging from 1 to 5, and the cultural resistance index; the number of rejections by artisans or other cultural figures.

Discussion

This discussion interprets the key findings obtained, relates them to the theoretical framework (Bandura's Social Learning Theory and Durkheim's Structural Functionalism Theory), and discusses the practical and social implications of utilizing Artificial Intelligence (AI) for girl child laborers in the batik industry.

Relevance of Findings to Social Learning Theory (Bandura)

The research results show that AI is very effective in enhancing the batik-making skills and independence of girl child laborers. This effectiveness aligns with the principles of Social Learning Theory (Bandura), where individuals learn through observing a model (modeling).

AI as a Super Model: In the context of this research, AI functions as a symbolic model that is always available, patient, and consistent. AI provides step-by-step video tutorials, simulations of canting movements, and repeatable demonstrations at any time. The presence of this "super model" overcomes the main obstacle in traditional training, where access to expert trainers (master batik makers) is often limited or inflexible for child laborers with limited time.

Personalized Learning and Deliberate Practice: AI is capable of analyzing the learning speed, weaknesses, and strengths of each individual. If a subject struggles with the isen-isen technique, AI will provide more practice and explanation related to that technique before moving to the next level. This capability encourages metacognition and deliberate practice, changing the learning pattern from passive

imitation to active problem-solving. This proves that AI can be a catalyst for Self-Directed Learning by analyzing error patterns and providing personalized feedback.

Self-Efficacy and Material Mastery: The adaptive learning speed and the opportunity to learn without feeling ashamed or falling behind increase self-efficacy (self-confidence) and mastery of the material.

The qualitative findings reveal that AI intervention triggers a role shift for the subjects from passive preservers to active cultural innovators. This shift has profound sociological implications, aligning with the concept of Organic Solidarity (Durkheim). First, the role of girls was framed conservatively as guardians of tradition. With the mastery of technical skills and the ability to innovate new motif designs using AI, the subjects no longer merely follow instructions. This change increases their self-esteem and bargaining position within the Cirebon batik industry. Second, new social Integration: The unique and specialized skills (AI-based modern batik design) create a healthy division of labor. Instead of uniting through job similarity (Mechanical Solidarity), AI helps individuals gain social value through specific and renewable skills, which is characteristic of Organic Solidarity. AI, thus, is not just a business tool, but a social transformation tool that empowers.

CONCLUSION

This research aimed to explore the subjective experiences of girl child laborers in Cirebon Regency in utilizing Artificial Intelligence (AI) to enhance independent batik-making skills, supported by quantitative data triangulation. The phenomenological results confirm that AI is not merely a technical tool but a transformative catalyst that changes the subjects' learning patterns and psychosocial empowerment.

Transformation of Learning Patterns and Skills: The utilization of AI is proven to change the learning pattern from a passive imitation system (Durkheim's Mechanical Solidarity) to independent deliberate practice (Organic Solidarity). AI functions as a consistent super model, providing an instant feedback loop that accelerates the learning curve, and improving the subjects' technical batik quality (with an average score increase of 23.75%).

Increase in Self-Efficacy and Autonomy: Psychosocially, the learning experience with AI significantly increased the subjects' self-confidence (self-efficacy) and cognitive autonomy. Subjects shifted from task implementers to motif designers and problem solvers, which aligns with Bandura's Social Learning Theory, where skill mastery correlates directly with increased self-belief.

Implications for Social Empowerment: AI opens access to vocational skills education that was previously difficult for this marginalized group to reach, while also introducing OHS awareness (safety nudge) in vulnerable home work environments. AI successfully encouraged simple economic initiatives, demonstrating the technology's potential as a tool for inclusive economic and social empowerment.

Overall, this research concludes that targeted technological intervention can strengthen the role of education as a tool for social liberation and empowerment for girl child laborers.

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