Understanding Knowledge Acquisition, Adaptive Strategies, Challenges, and Preservation Methods Among Traditional Fishermen in a Digital Age

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Abstract.

The Riau Islands (Kepri) province of Indonesia boasts an expansive ocean, covering 96% of its territory and fostering a rich heritage of knowledge and maritime culture among its citizens. Traditional fishing communities on Riau Island have thrived for generations, drawing on ancestral wisdom and local expertise. However, the swift rise of digitalization and modernization has triggered a transformative shift in their learning methods and adaptation strategies. This study focuses on: identifying methods of knowledge acquisition, investigating adaptive strategies, unveiling challenges, and exploring knowledge preservation techniques. Through in-depth interviews with more than two decades of experienced fishermen, qualitative data was gathered and meticulously analyzed using NVivo 12 software. The result found that traditional fishermen employ diverse strategies, integrating technology, continuous learning, and data-driven decision-making. They face challenges like limited internet access, cultural traditions, and safety concerns. Yet they preserve wisdom through oral traditions, apprenticeships, and modern tools, ensuring a vibrant fishing legacy. Their resilience highlights the urgent need for digital adaptation and intergenerational dialogue to shape sustainable and innovative fishing communities. Hence, this study recommend to develop sustainable training initiatives, establish community platforms, formulate policies to enhance digital accessibility, and encourage meaningful conversations across generations within traditional fishing communities.

1 Introduction

The blue economy is a concept of sustainable economic development that focuses on the sustainable use of marine and coastal resources. This concept is important to apply in Indonesia, considering the country has a very large water area, namely around 5.7 million square kilometers. In its implementation, the blue economy needs to involve traditional
fishermen. Traditional fishermen have extensive knowledge and experience about the sea and coast. They have adapted to the dynamic and complex marine environment for centuries.

To be able to contribute optimally to the blue economy, it is important to learn how traditional fishermen learn. Their way of learning is very different from the way of learning in formal schools. They learn through direct experience, observation, and guidance from their parents or seniors. To achieve a blue economy in accordance with its principles, efforts are needed from various parties, both government, private sector and society. The government can provide access to formal and non-formal education for traditional fishermen. The private sector can provide assistance in the form of equipment and technology. The community can help preserve the marine environment. Understanding how traditional fishermen learn and pass on knowledge is important to apply in the blue economy. This will help traditional fishermen to adapt to changes and challenges of the times, and to contribute optimally to sustainable economic development. By studying the ways of traditional fishermen, we can build a more inclusive and sustainable blue economy.

The Riau Islands (Kepri) province of Indonesia is characterized by a vast ocean, covering 96% of its territory, with only 4% land. The Riau Islands are one of the regions in Indonesia that have great blue economy potential. This region has a long coastline, a wealth of marine and freshwater resources, and high biodiversity. As a result, the people of the Riau Islands have long been closely intertwined with the sea, cultivating a rich heritage of knowledge, insight, and unique maritime culture. Mastery of the art and science of sea fishing demands a deep level of intelligence and understanding, as it includes a complex body of knowledge. Hence, Kepri is one of the regions interesting to explore their fishermen life and learning strategies in fishing.

In the blue economy concept, traditional fishermen have an important role. Traditional fishermen are a group of people who have lived and depended on the sea for a long time. They have local knowledge and wisdom that is important for sustainable management of marine and freshwater resources. Therefore, paying attention to traditional fishermen is important for the successful implementation of the blue economy in the Riau Islands. This can be done in various ways, including. However, it should be noted that traditional fishermen and fishing community elders in the Riau Islands usually have a lower level of formal education. Therefore, it would be very interesting to know how they gained knowledge about catching fish in the sea, how they learned about astronomy, weather, and sea conditions, and how they use fishing gear.

Kepri is a border area close to a busy shipping lane and is a hub for rapid change in the maritime and fisheries industry, driven by technological progress. This change has a significant impact on traditional fishermen, as the convergence of globalization and technological advances is reshaping the landscape of traditional knowledge transmission and adaptation strategies. As digitalization penetrates all corners of the world, traditional fishermen in the Riau Islands are experiencing major changes in their learning methods, approach to accessing knowledge, and preservation of knowledge that is crucial for their livelihoods. Therefore, we also need to understand how traditional fishermen adapt to digital technology and whether they are open enough to technological changes and adapt to the fishing process, and its barriers as well.

Moreover, it is also essential to understand how traditional elder fishermen pass down and preserve their knowledge is essential for many reasons. It plays a pivotal role in cultural preservation, safeguarding unique and valuable practices related to the sea and fishing techniques. This knowledge also holds the key to sustainable fishing practices, which are vital for the long-term health of marine ecosystems. Additionally, it empowers fishing communities with resilience, helping them adapt to changing circumstances and economic shifts. Moreover, it sheds light on how traditional wisdom interacts with modern technology, fostering the development of hybrid approaches. Furthermore, it informs education and
training programs for the younger generation, ensuring the transfer of essential skills and knowledge. Lastly, it inspires research and innovation, offering novel solutions and techniques beyond the realm of fishing. In essence, unraveling the methods of knowledge transmission among elder fishermen serves as a vital bridge between tradition and progress, with far-reaching implications for culture, sustainability, and community well-being.

To better understand the ongoing transition of traditional fishermen in the Riau Islands to the digital era, it is important to apply concepts from Human Resource Development (HRD). HRD is a multidisciplinary field that studies how individuals and organizations acquire, develop, and use knowledge and skills to achieve their goals and adapt to change. Several key HRD theories and concepts are relevant to understanding how traditional fishermen navigate the digital era in seeking knowledge and skills related to fishing techniques, including: 1. Lifelong Learning, the concept of lifelong learning emphasizes the continuous acquisition of knowledge and skills throughout one's life [1]. Traditional fishermen are facing the need to embrace lifelong learning as they adapt to new technologies and changing environmental conditions. 2. Knowledge Management, this theory focuses on how organizations create, share, and use knowledge [2]. It can help us understand how traditional fishermen share and preserve their traditional knowledge in the digital age. 3. Learning Organizations: This concept refers to an organization that is constantly learning and adapting to change [3]. It can help us understand how traditional fishing communities can become more resilient and adaptable in the face of rapid technological change. 4. Cultural Adaptation [4], this concept refers to the process of adapting to a new culture. It can help us understand how traditional fishermen adapt their traditional knowledge and practices to the digital era.

ASEAN has three blue economy principles[1], namely:

1. **Value creation**: Creating economic value while ethically managing marine and freshwater resources.
2. **Inclusion**: Ensuring that all stakeholders benefit from the sustainable use of marine and freshwater resources.
3. **Sustainability**: Ensuring that marine and freshwater resources are used effectively to safeguard the environment and society.

ASEAN's blue economy sustainability principles emphasize the importance of involving all stakeholders in the decision-making process. This can be done by learning from the experience and knowledge of various parties, including local communities, academics, and the private sector. ASEAN's blue economy sustainability principles emphasize the importance of considering the environmental and social impacts of blue economy activities. This can be done by finding out the challenges in gaining environmental and social knowledge. ASEAN's principle of blue economy inclusivity emphasizes the importance of ensuring that everyone has access to the benefits of the blue economy. This can be done by passing on knowledge and understanding about the blue economy to the younger generation. Therefore, this study aims to identify knowledge acquisition methods, investigate adaptive strategies, uncover challenges, and explore knowledge preservation methods of traditional fishermen in Kepri. This study will provide valuable insights into the dynamics of knowledge transfer and sustainability within traditional fishing communities in a rapidly changing world, which is in line with ASEAN's principle of blue economy.

### 2 Research Methodology

This qualitative study employs a methodological approach centered on in-depth interviews with elder fishermen who have dedicated over two decades of their lives as fishermen. By engaging with this specific cohort of experienced fishermen, the research aims to tap into a wealth of knowledge, experience, and wisdom that has been cultivated over years of practical
engagement with the marine environment. In-depth interviews serve as the primary data collection method, allowing researchers to delve deeply into the nuances of their learning practices and knowledge transmission. The deliberate selection of elder fishermen as interviewees ensures that the study captures insights deeply rooted in traditional fishing practices, providing a valuable perspective on the intersection of tradition and digitalization. These interviews are conducted in a semi-structured format, allowing for open-ended questions that encourage interviewees to share their experiences and perspectives freely. Through this method, the research aims to unearth rich, context-specific information that enriches the understanding of how traditional fishermen adapt and learn in the digital age.

The data collected from these in-depth interviews are subjected to rigorous analysis using NVivo 12, a powerful qualitative data analysis software. NVivo 12 aids in the systematic organization and categorization of the qualitative data, enabling researchers to identify recurring themes, patterns, and insights. Thematic analysis is the chosen analytical approach for this study, as it allows for the identification and interpretation of key themes and patterns within the interview data [5]. By employing thematic analysis, the research aims to distill the rich narratives and perspectives provided by the elder fishermen into meaningful themes that address the study's objectives, such as understanding knowledge acquisition methods, adaptive strategies, challenges faced, and knowledge preservation practices. This analytical approach ensures that the study's findings are grounded in the voices and experiences of the participants, contributing to a nuanced and contextually relevant understanding of how traditional fishermen navigate the digital age in their pursuit of fishing knowledge and skills.

3 Result and Discussion

The discussion of the data collection results will be organized according to the four research questions: (1) knowledge acquisition methods, (2) adaptive strategies, (3) challenges, and (4) knowledge preservation methods.

3.1 Knowledge Acquisition Methods

Fishermen in the digital era acquire knowledge and skills related to fishing techniques by blending traditional practices, mentorship, and apprenticeships with modern technology, adaptive learning strategies, and a strong commitment to sustainability. This multifaceted approach allows them to continually evolve and adapt their fishing techniques in response to changing circumstances. We synthesize the results from interviews with traditional fishing elders to identify themes that categorize how fishermen acquire knowledge and skills related to fishing techniques:

- **Incorporation of Technology**: Fishermen in the digital era are increasingly incorporating technology into their learning processes. They utilize tools such as GPS navigation systems, fish finders, and data collection apps to enhance their understanding of fishing locations and conditions. Technology assists in optimizing fishing practices and improving catch rates.

- **Adaptive Learning Strategies**: Fishermen are adaptive learners, actively seeking ways to adapt to changing environmental conditions and fishing landscapes. They stay updated with technological advancements and employ digital resources, such as online tutorials and fishing apps, to acquire new knowledge and skills.

- **Mentorship and Apprenticeship**: Traditional methods of knowledge transfer continue to play a vital role. Apprenticeships and mentorship relationships are common, where experienced fishermen pass down their skills, techniques, and wisdom to the younger generation. This form of learning ensures the preservation of time-tested methods.
-Balancing Traditional and Modern Knowledge: Fishermen recognize the value of both traditional wisdom and modern scientific knowledge. They often combine the insights gained from generations of fishing experience with contemporary data-driven approaches to make informed decisions.
-Community and Collaboration: Fishermen frequently collaborate within their communities and with other stakeholders. Knowledge-sharing within local fishing associations and participation in community workshops enable them to exchange insights, strategies, and best practices for effective fishing techniques.
-Conservation and Sustainability: There is a growing emphasis on sustainable fishing practices. Fishermen acquire knowledge about conservation and sustainability principles, often in collaboration with scientists and environmental organizations. They aim to minimize the impact on marine ecosystems and ensure the long-term viability of their livelihoods.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology incorporation</td>
<td>Use of digital tools to enhance understanding of fishing locations and conditions</td>
<td>GPS navigation systems, fish finders, data collection apps</td>
</tr>
<tr>
<td>Adaptive learning strategies</td>
<td>Active seeking of ways to adapt to changing environmental conditions and fishing landscapes</td>
<td>Online tutorials, fishing apps</td>
</tr>
<tr>
<td>Mentorship and apprenticeship</td>
<td>Traditional methods of knowledge transfer from experienced fishermen to the younger generation</td>
<td>Apprenticeships, mentorship relationships</td>
</tr>
<tr>
<td>Balancing traditional and modern knowledge</td>
<td>Combination of insights gained from generations of fishing experience with contemporary data-driven approaches</td>
<td>Use of traditional fishing methods alongside modern scientific knowledge</td>
</tr>
<tr>
<td>Community and collaboration</td>
<td>Knowledge-sharing within local fishing associations and participation in community workshops</td>
<td>Exchange of insights, strategies, and best practices for effective fishing techniques</td>
</tr>
<tr>
<td>Conservation and sustainability</td>
<td>Acquisition of knowledge about conservation and sustainability principles</td>
<td>Collaboration with scientists and environmental organizations</td>
</tr>
</tbody>
</table>

Table 1. Knowledge Acquisition Method of Traditional Fishermens in Riau Island, Indonesia

3.2 Adaptive Strategies

Fishermen in the digital era employ adaptive strategies that combine traditional wisdom with modern technology and data-driven approaches. Their commitment to continuous learning, collaboration, and environmental responsibility ensures that they can thrive in the ever-evolving fishing landscape. These strategies enable them to adapt to changing conditions, make informed decisions, and sustain their livelihoods. We synthesize the results from
interviews with traditional fishing elders to identify themes that categorize about what is adaptive strategies employed by fishermen in their learning processes within the digital era:

-Incorporation of Technology: Fishermen actively embrace digital tools and technologies. They utilize GPS navigation systems, fish finders, and smartphone apps to gather real-time data on weather, water conditions, and fish behavior. This integration of technology enhances their ability to make informed decisions while out at sea.

-Continuous Learning: Fishermen display a commitment to continuous learning. They recognize the rapid evolution of fishing techniques and equipment and strive to stay updated. Online resources, such as YouTube tutorials and fishing forums, provide them with access to a vast knowledge base.

-Data-Driven Decision-Making: Fishermen rely on data-driven decision-making processes. They collect and analyze data from their own experiences and collaborate with others to create a collective knowledge pool. This approach helps them adapt their strategies to changing conditions and improve their catch rates.

-Adaptive Gear and Tackle: Fishermen adapt their gear and tackle to match specific conditions and target species. They experiment with different types of lures, bait, and fishing techniques, tailoring their equipment to maximize success in varying environments.

-Networking and Collaboration: Fishermen actively engage in networking and collaboration. They connect with other fishermen, researchers, and experts in the field. Collaborative efforts allow them to exchange insights, share best practices, and gain a broader perspective on fishing techniques.

-Environmental Awareness: An essential adaptive strategy is environmental awareness. Fishermen closely monitor environmental changes and adapt their practices to minimize their impact on marine ecosystems. Sustainability practices are increasingly integrated into their learning processes.

-Balancing Tradition and Innovation: Fishermen strike a balance between traditional wisdom and modern innovation. They respect the knowledge passed down through generations while being open to incorporating new ideas and technologies that improve their fishing efficiency.

-Resilience and Problem Solving: Fishermen exhibit resilience and problem-solving skills. They adapt to unforeseen challenges, such as changing regulations or climate-related issues, by finding creative solutions and adjusting their approaches accordingly.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology incorporation</td>
<td>Active embracement of digital tools and technologies</td>
<td>GPS navigation systems, fish finders, smartphone apps</td>
</tr>
<tr>
<td>Continuous learning</td>
<td>Commitment to staying updated on the latest fishing techniques and equipment</td>
<td>YouTube tutorials, fishing forums</td>
</tr>
<tr>
<td>Data-driven decision-making</td>
<td>Reliance on data-driven decision-making processes</td>
<td>Collection and analysis of data from own experiences and collaboration with others</td>
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</table>
### 3.3 Challenges of Knowledge Acquisition

Fishermen face a range of challenges when pursuing knowledge acquisition, including technological, access-related, informational, cultural, financial, environmental, regulatory, safety, and time-related hurdles. Overcoming these challenges requires a combination of adaptive strategies, community support, and a commitment to lifelong learning in the fishing industry. We synthesize the results from interviews with traditional fishing elders to identify themes that categorize its challenges faced by fishermen while pursuing knowledge acquisition:

- **Technological Barriers**: Fishermen encounter challenges related to the adoption of new technologies. Some may struggle to operate digital tools and equipment, hindering their ability to access and utilize valuable online resources.
- **Access to Resources**: Limited access to the internet and digital resources is a significant challenge, especially for fishermen in remote or underserved areas. This digital divide can impede their ability to gather information and learn from online platforms.
- **Information Overload**: With the abundance of information available online, fishermen may find it overwhelming to sift through and identify relevant and accurate sources. Discerning credible information from less reliable content can be challenging.
- **Language Barriers**: Language barriers can be an obstacle, as not all online resources are available in languages that fishermen are proficient in. This limits their access to valuable knowledge and instructional content.
- **Financial Constraints**: Acquiring new technology and equipment can be costly. Some fishermen may face financial constraints that prevent them from investing in modern tools and resources, limiting their ability to keep up with advancements.

<table>
<thead>
<tr>
<th>Adaptive gear and tackle</th>
<th>Adaptation of gear and tackle to match specific conditions and target species</th>
<th>Experimentation with different types of lures, bait, and fishing techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networking and collaboration</td>
<td>Active engagement in networking and collaboration with other fishermen, researchers, and experts</td>
<td>Exchange of insights, sharing of best practices, and gaining of a broader perspective on fishing techniques</td>
</tr>
<tr>
<td>Environmental awareness</td>
<td>Close monitoring of environmental changes and adaptation of practices to minimize impact on marine ecosystems</td>
<td>Integration of sustainability practices into learning processes</td>
</tr>
<tr>
<td>Balancing tradition and innovation</td>
<td>Striking a balance between traditional wisdom and modern innovation</td>
<td>Respect for knowledge passed down through generations while being open to incorporating new ideas and technologies</td>
</tr>
<tr>
<td>Resilience and problem solving</td>
<td>Demonstration of resilience and problem-solving skills</td>
<td>Adaptation to unforeseen challenges by finding creative solutions and adjusting approaches accordingly</td>
</tr>
</tbody>
</table>

#### 3.4 Adaptation Strategies

Fishermen display a commitment to continuous learning. They adapt to unforeseen challenges, such as changing regulations or climate, and improve their problem-solving skills. They respect the knowledge passed down through generations while being open to incorporating new ideas and technologies.

Fishermen adapt their gear and equipment to match specific conditions and target species. They actively engage in networking and collaboration with other fishermen, researchers, and experts. They connect with other fishermen, researchers, and experts in the field.

Fishermen exhibit resilience and problem-solving skills. They recognize the rapid evolution of fishing techniques and equipment and strive to keep up with advancements. They utilize modern tools and resources, increasing their ability to adapt to changing conditions.

Fishermen actively embrace digital technologies, such as apps and websites, to maximize their ability to adapt. They use GPS and navigation systems to find the best fishing locations. They use YouTube tutorials to experiment with different gear, bait, and fishing techniques.
- **Cultural and Traditional Values:** Balancing traditional knowledge and practices with modern approaches can be a challenge. Some fishermen may be resistant to change due to the cultural and historical significance of traditional methods.

- **Environmental Challenges:** Fishermen must contend with environmental challenges such as climate change, overfishing, and habitat degradation. These challenges can disrupt fishing patterns and require ongoing adaptation.

- **Regulatory and Compliance Issues:** Fishing regulations and compliance requirements can be complex and vary by region. Fishermen must invest time in understanding and adhering to these rules, diverting their focus from knowledge acquisition.

- **Safety Concerns:** Safety at sea is a paramount concern. Fishermen need to prioritize safety training and practices, which may compete with time spent on learning about new fishing techniques.

- **Time Constraints:** The demands of daily fishing operations can leave fishermen with limited time for formal learning or training. They often need to balance knowledge acquisition with the practical aspects of their profession.

### Table 3. Challenges of knowledge acquisition faced by Traditional Fishermens in Riau Island, Indonesia

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological barriers</td>
<td>Difficulty in operating digital tools and equipment</td>
</tr>
<tr>
<td>Access to resources</td>
<td>Limited access to the internet and digital resources</td>
</tr>
<tr>
<td>Information overload</td>
<td>Difficulty in identifying relevant and accurate information online</td>
</tr>
<tr>
<td>Language barriers</td>
<td>Lack of access to online resources in their native language</td>
</tr>
<tr>
<td>Financial constraints</td>
<td>Cost of acquiring new technology and equipment</td>
</tr>
<tr>
<td>Cultural and traditional values</td>
<td>Resistance to change due to the significance of traditional methods</td>
</tr>
<tr>
<td>Environmental challenges</td>
<td>Need to adapt to changing environmental conditions</td>
</tr>
<tr>
<td>Regulatory and compliance issues</td>
<td>Complexity of fishing regulations and compliance requirements</td>
</tr>
<tr>
<td>Safety concerns</td>
<td>Need to prioritize safety training and practices</td>
</tr>
<tr>
<td>Time constraints</td>
<td>Limited time for formal learning or training</td>
</tr>
</tbody>
</table>

### 3.4 Knowledge Preservation Methods

Fishermen employ a variety of methods, including oral tradition, apprenticeships, community-based learning, cultural practices, written documentation, technology-assisted learning, workshops, and the involvement of elders, to pass down and preserve their acquired knowledge for future generations. These methods help ensure the continuity of fishing traditions and practices. We synthesize the results from interviews with traditional fishing
elders to identify themes that categorize the method used by fishermen to pass down and preserve their acquired knowledge for future generations:

- **Oral Tradition:** Fishermen rely on oral tradition to transmit knowledge across generations. They engage in storytelling and verbal exchanges to share fishing techniques, experiences, and wisdom. This ensures that traditional knowledge is passed down orally.

- **Apprenticeships:** Many fishermen follow the apprenticeship model, where younger individuals learn from experienced mentors. This hands-on approach allows for the transfer of practical skills and knowledge from one generation to the next.

- **Community-Based Learning:** Fishing communities often come together to share knowledge and experiences. This collaborative learning environment allows for the exchange of ideas and techniques among peers, fostering a sense of community and shared wisdom.

- **Cultural Practices:** Fishing knowledge is intertwined with cultural practices. Fishermen preserve their heritage by integrating traditional rituals and customs into their fishing activities, ensuring that cultural aspects are passed down.

- **Written Documentation:** Some fishermen create written documentation, such as journals or logs, to record their experiences and observations. These documents serve as a written record of their knowledge and can be shared with future generations.

- **Technology-Assisted Learning:** While some fishermen face challenges with technology adoption, others use digital tools to document and share their knowledge. Online forums, social media, and video platforms enable them to reach wider audiences, including younger generations.

- **Workshops and Training Programs:** Fishermen participate in workshops and training programs that are designed to pass on specialized knowledge. These formal educational settings provide structured learning experiences.

- **Elders as Knowledge Keepers:** Older generations of fishermen, often referred to as "knowledge keepers," play a crucial role in passing down wisdom and expertise to younger members of the community. They are respected for their experience and insight.

- **Adaptation to Modern Tools:** Some fishermen adapt their traditional knowledge to work with modern technology and equipment. This allows for the incorporation of new methods while preserving the core principles of their craft.

- **Storytelling Events:** Fishing communities may organize storytelling events or gatherings where elders share their stories and knowledge with the younger generation. These events serve as a way to celebrate and preserve cultural and fishing heritage.

**Table 4. Knowledge Preservation Methods Adopted by Traditional Fishermen in Riau Island, Indonesia**

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral tradition</td>
<td>Storytelling and verbal exchanges to share fishing techniques, experiences, and wisdom</td>
</tr>
<tr>
<td>Apprenticeships</td>
<td>Hands-on learning from experienced mentors</td>
</tr>
<tr>
<td>Community-based learning</td>
<td>Collaborative learning and exchange of ideas among peers</td>
</tr>
</tbody>
</table>
Cultural practices | Integration of traditional rituals and customs into fishing activities
Written documentation | Journals or logs to record experiences and observations
Technology-assisted learning | Use of digital tools to document and share knowledge
Workshops and training programs | Structured learning experiences on specialized knowledge
Elders as knowledge keepers | Respect for the experience and insight of older generations
Adaptation to modern tools | Incorporation of new methods while preserving traditional principles
Storytelling events | Celebration and preservation of cultural and fishing heritage

### 3.5 Discussion

The synthesis of some previous studies reveals significant insights into the adaptive strategies employed by fishermen and provides valuable parallels to contemporary research in the field. Firstly, a consistent theme across these studies is the emphasis on local wisdom and traditional knowledge as pivotal elements in addressing the challenges posed by environmental changes. Fishermen, as highlighted in [7], relied on inherited knowledge to reactively adapt, diversify their jobs, modify boats, and rehabilitate damaged ecosystems, underlining the importance of integrating traditional wisdom with modern approaches.

Secondly, the emphasis on community collaboration and solidarity emerges as a key adaptive strategy. [7] demonstrated how fishermen engaged collectively, working collaboratively with their communities to restore damaged ecosystems. Similarly, [8] showcased the significance of social capital and family solidarity, emphasizing the collective nature of adaptation efforts, a sentiment echoed in contemporary literature discussing collaborative learning environments within fishing communities.

Furthermore, the diversification of income sources emerges as a critical adaptive response. Fishermen, as depicted in [7], diversified their jobs and modified their boats, indicating a shift away from sole reliance on traditional fishing methods. [10] reinforced this by introducing climate-smart agriculture as an additional income source, underlining the necessity of diverse livelihoods in the face of changing environmental conditions.

A noteworthy insight from [10] is the hesitance among some fishermen to expect their children to inherit the profession due to increased awareness of climate change impacts. This highlights a concern about the sustainability of traditional fishing practices, echoing sentiments expressed in the interviews about the importance of preserving traditional knowledge for future generations.

Lastly, these studies underscore the influence of policies and institutions on fishermen's adaptive strategies. [8] revealed the varied effects of institutions on entrepreneurial orientation and family solidarity, emphasizing the role of policies in shaping adaptive strategies within fishing communities. [10] highlighted the need for comprehensive climate adaptation policies, indicating the importance of national-level initiatives in guiding fishermen's decisions and practices.

Incorporating these insights into contemporary academic discourse can enhance our understanding of the nuanced and context-specific adaptive strategies employed by
fishermen, providing a broader perspective on the challenges and opportunities faced by fishing communities in adapting to environmental changes. Therefore, the research provides recommendations that can be implemented for better and more sustainable progress of traditional fishermen:

1. Sustainable Training Programs:
This recommendation emphasizes the importance of adapting training programs to the digital era while honoring traditional learning methods. By combining both traditional techniques and digital tools in training, fishermen can benefit from a comprehensive learning experience that suits their diverse learning styles. This approach ensures that valuable traditional knowledge is not lost while integrating new technological advancements, fostering a balanced and sustainable learning environment.

2. Creating Community Platforms:
The idea of creating community platforms, such as physical workshops and online forums, addresses the challenge of knowledge exchange among geographically dispersed fishermen. These platforms serve as spaces where fishermen can come together to share their knowledge and experiences. Physical workshops provide face-to-face interactions, while online forums facilitate discussions regardless of location. By encouraging collaboration and the sharing of insights, these platforms enhance collective learning, enabling fishermen to benefit from each other’s expertise and wisdom.

3. Improving Digital Access and Training:
In the digital era, access to technology is crucial for fishermen to stay updated with modern fishing practices. This recommendation suggests implementing policies that improve digital access and provide training. By enhancing digital literacy and ensuring availability of digital resources, fishermen can overcome technological barriers. Training programs tailored to their needs enable them to effectively utilize digital tools such as apps, GPS systems, and online tutorials. Improved access and training empower fishermen to harness the benefits of digital technologies for their profession.

4. Encouraging Intergenerational Dialogue:
Preserving traditional wisdom is vital for the continuity of fishing practices. Encouraging intergenerational dialogue fosters the transfer of knowledge from older, experienced fishermen to younger generations. By facilitating conversations and mentorship between these age groups, cultural heritage and time-tested techniques can be passed down. This dialogue not only preserves valuable traditions but also ensures that younger fishermen learn from the rich experiences of their predecessors, fostering a strong sense of community and preserving the unique fishing heritage of the region.

4 Conclusion
This study unravels the intricate learning paths and adaptation strategies of traditional fishermen on Riau Island in the digital age. By addressing the objectives of identifying knowledge acquisition methods, investigating adaptive strategies, uncovering challenges, and exploring knowledge preservation methods, this study provides valuable insights into the dynamics of knowledge transfer and sustainability within traditional fishing communities in a rapidly changing world.

The findings highlight the importance of adapting to the digital era, fostering knowledge exchange and collaboration, improving digital access and training, and encouraging intergenerational dialogue. These insights can be leveraged to develop
sustainable training programs, create community platforms, implement policies that improve
digital access and provide training, and promote intergenerational dialogue. By taking these
steps, we can support traditional fishermen in navigating the digital age and preserving their
valuable knowledge and practices.

Future research needs to discuss inclusiveness and equality of fishermen. Studies on
gender inclusiveness in traditional fishermen, involving the role of women in fishing
activities as well as their role in decision making and economic empowerment. In the future,
it will also be interesting to study inter-country cooperation: Research could involve analysis
of cross-border cooperation between countries in maintaining the sustainability of traditional
fishermen, including sharing resources across countries and addressing common problems
related to marine fisheries.

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and expectations for their children to pursue the same profession in Chumphon