Beyond Technology: Knowledge and Skills as Productive Capability among Small Fishery Entrepreneurs in Malaysia

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ABSTRACT

Knowledge and practical skills may help small fishery entrepreneurs translate experience into production routines. This study examines how knowledge and skills emerge as an enterprise-level productive capability when contextual experience is considered alongside structured expert judgement. A sequential exploratory mixed-methods design integrates eleven anonymised interview documents from Kelantan and Terengganu, Malaysia, with five knowledge-related questionnaire columns containing 32 response rows and 160 complete ratings. The supplied questionnaire asks about respondents' own understanding, practices and perceived abilities; the fuzzy analysis therefore assesses convergence in self-reports rather than expert endorsement of indicator relevance. Fuzzy Delphi acceptance requires mean distance ≤ 0.20, at least 75% consensus and centroid ≥ 0.50. Knowledge management comprises 27 coded references across eleven documents; six partly co-coded labour-skill entries inform practical application. Three of five columns satisfy all criteria: Items 2, 4 and 5, with centroids of 0.6313, 0.6833 and 0.6167. The supplied questionnaire associates these items with new techniques, experience sharing and data-based decisions, subject to confirmation of its correspondence to the response matrix. Items 1 and 3 fail consensus, indicating uneven convergence rather than rejection of record keeping or hygiene. Integration distinguishes reported understanding from application and identifies where broad qualitative accounts exceed questionnaire coverage. Knowledge and practical skills remain proposed independent constructs, without separate validated scales or estimated production effects. The contribution is an exploratory account of knowledge in use and its uneven translation into structured self-reports. Respondent eligibility, questionnaire-version linkage and observed task performance require further verification before operational measurement.

Keywords: small fishery entrepreneurs; knowledge and skills; productive capability; Fuzzy Delphi Method; mixed methods

INTRODUCTION

Small-scale fisheries support livelihoods, food systems and coastal economies (FAO, Duke University, & WorldFish, 2023; Salmi et al., 2024). Within this setting, entrepreneurs draw on experience, learning and practical judgement when organising production. This article focuses on knowledge and skills as the proposed independent constructs, examining what participants report and which corresponding statements achieve agreement. It does not analyse other explanatory factors or estimate a production-efficiency outcome model.

The national and state contexts are also economically significant. Official Department of Fisheries data show that registered establishments landed 1,270,277 metric tonnes of marine fish in Malaysia in 2023. Kelantan

accounted for 60,032 metric tonnes and Terengganu for 45,701 metric tonnes; together, the two study states represented 8.32% of the national total (Department of Statistics Malaysia [DOSM], 2026). These figures describe landings at registered establishments rather than the production efficiency of individual entrepreneurs, but they establish the scale and relevance of the study setting.

Knowledge and skills require distinct conceptual attention. Knowledge concerns understanding procedures, records and production-related decisions; skills concern applying understanding to a practical task. A capability perspective directs attention to what actors are able to do with their know-how, while fisheries capability research supplies a conceptual parallel rather than direct evidence of enterprise productivity effects (Wiranthi et al., 2024). The present analysis consequently distinguishes reported understanding from demonstrated performance.

Knowledge is therefore more than information possessed by an entrepreneur (N'Guetta, 2025; Yamin et al., 2025). In this study, the knowledge-related accounts concern experience, standard operating procedures, record keeping, problem solving, learning and day-to-day decisions (see Section 4.2). Fishers' situated knowledge has also been shown to illuminate socio-ecological change, while knowledge sharing and advocacy can strengthen stewardship pathways and adaptive capacity (N'Guetta, 2025; Scalisi et al., 2024). These studies suggest that knowledge becomes consequential through practice. However, identifying knowledge as salient in participants' accounts does not by itself establish that it is a causal determinant of productivity, nor does frequency of mention provide an economic effect size.

The unresolved issue is the transition from broad accounts of knowledge-related practice to specific self-referential statements. Studies of capabilities, stewardship and adaptation establish the relevance of knowledge in different fisheries settings, but their outcomes and units of analysis differ from enterprise production (Scalisi et al., 2024; Wiranthi et al., 2024; Yamin et al., 2025). Here, qualitative accounts can identify meaningful practices, while questionnaire responses indicate whether entrepreneurs report those practices or abilities. The research gap concerns how these forms of evidence align within small fishery enterprises, rather than whether agreement alone validates a productive-capability measure.

Mixed-methods integration requires an explicit account of how evidence is connected across phases (Fetters & Tajima, 2022; Guetterman et al., 2021). Frequent interview discussion cannot establish uniform practice among questionnaire respondents. The present joint display therefore compares thematic meanings with agreement on specific self-reports, preserving both convergence and divergence. Its contribution is a context-specific application of integration, rather than a new integration method.

The research aim is to examine how knowledge and skills emerge as an enterprise-level productive capability when contextual experience is considered alongside structured expert judgement. The research question remains: How do knowledge and skills emerge as an enterprise-level productive capability when small fishery entrepreneurs' contextual experiences are integrated with structured expert judgement?

The questionnaire ratings concern respondents' personal knowledge and practices. Interpreting them as expert assessments would require documented panel expertise and instructions for evaluating indicators. The analysis therefore addresses the stated aim through contextual accounts and structured agreement within these evidential limits.

LITERATURE REVIEW

Knowledge and skills as a provisional productive capability

Capability-oriented analysis considers both the resources available and what actors can achieve with them. Wiranthi et al. (2024) distinguish the resources available to fisher groups from the capabilities required to participate in and benefit from sustainability certification. Their findings also highlight the importance of supportive external conditions, because capabilities are exercised within institutional environments.

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Knowledge is defined as production-related understanding acquired through learning and experience, including procedures, record use and decision making. Practical skills refer to the ability to apply know-how in enterprise activities. The qualitative code labels "Knowledge management" and "Labour Skill" provide evidence relevant to these concepts. The five-item questionnaire block addresses understanding and practice but does not establish two separate measurement scales. Productive capability remains an interpretive concept connecting knowledge and practical skills.

The analysis distinguishes reported understanding, reported practice, demonstrated competence and measured production performance. Interview accounts and the self-referential questionnaire address the first two. Fuzzy convergence summarises those questionnaire ratings; it is not a separate observation of competence. Situated-knowledge and knowledge–action studies provide conceptual parallels, while their different outcomes limit direct transfer to production claims (N'Guetta, 2025; Scalisi et al., 2024; Sokolova et al., 2025).

Table 1. Construct meanings and evidence boundaries

Construct	Evidence examined	Interpretation boundary
Knowledge	Procedures, records, learning and experience sharing	Reported understanding; not observed competence
Practical skills	Six partly co-coded Labour Skill entries and practical-application accounts	Qualitative construct; no separate validated quantitative scale
Knowledge-related item pool	Five original columns, three accepted	Statement agreement; wording provisional
Productive capability	Integration of reported know-how and practice	Exploratory interpretation; no dependent-variable model

Source: The qualitative analytical record, the supplied Questionaire.docx and the focused five-column fuzzy analysis. Questionnaire-to-workbook correspondence remains to be confirmed.

Recent sector reports establish the importance of small-scale fisheries to livelihoods and food systems, but do not identify a universal enterprise-level knowledge or skill score. Illuminating Hidden Harvests documents the contributions of small-scale fisheries (FAO, Duke University, & WorldFish, 2023), while the State of World Fisheries and Aquaculture reports situate capacity development within wider sector transformation (FAO, 2022, 2024). Salmi et al. (2024) discuss renewed attention to small-scale fisheries during crises. Official Malaysian landings data provide national and state context rather than measurements of entrepreneurs' competence (Department of Statistics Malaysia, 2026). These sources motivate the setting without establishing the effects examined here.

Experiential knowledge is situated in the activities through which it develops. Garavito-Bermúdez and Boonstra (2023) relate fishers' ecological knowledge to fishing styles, showing why different work practices can produce different forms of understanding. Silvano et al. (2023) describe fishers' knowledge as multidimensional and relevant to aquatic science. N'Guetta (2025) likewise foregrounds situated knowledge in understanding fisheries loss and damage. Their contribution to this study is conceptual: knowledge should be examined through its content and context, rather than assumed to be a uniform attribute shared equally by all entrepreneurs.

Studies comparing knowledge accounts with other evidence illustrate both their usefulness and the need for corroboration. Silas et al. (2023) compares seasonal interview accounts with field observations in East African fisheries. Ullah et al. (2023) examine how local ecological knowledge can support fisheries management in the Bay of Bengal, and Poissant et al. (2024) use fishers' knowledge to investigate fishing-induced changes in the Peruvian Amazon. These studies concern ecological observations and management, rather than enterprise productivity. They nevertheless support a relevant analytical principle: a reported understanding and an independently observed condition are different evidence sources whose agreement should be investigated.

Knowledge also develops through exchange. Gianelli et al. (2021) bring scientific and local knowledge together in addressing climate change in small-scale fisheries. Verschuur et al. (2025) propose an evaluative framework for integrating fishers' experiential knowledge into collaborative research. Sokolova et al. (2025) examines power relations in knowledge–action co-production. Together, these studies suggest that whose knowledge is elicited and how it is translated into research categories deserve explicit attention. They do not establish that interview themes will necessarily attract consensus when converted into questionnaire statements.

Learning and stewardship research further clarifies the range of outcomes associated with knowledge. Tam et al. (2021) investigate behavioural social learning in Chilean fishing communities; Laver et al. (2024) examine localised stewardship education in Nunatsiavut; and Scalisi et al. (2024) study stewardship capacity through fishers' knowledge and advocacy in Southeast Alaska. Such outcomes differ from production efficiency. These studies inform the treatment of learning and knowledge exchange, while their conservation and governance findings are not transferred directly into claims about Malaysian enterprise performance.

Capability-oriented fisheries research similarly distinguishes available resources from what actors can achieve. Wiranthi et al. (2024) examine group capabilities for small-scale tuna certification in Indonesia, whereas Yamin et al. (2025) investigate traditional knowledge and adaptive capacity among fishers in central Terengganu. Their different units of analysis and outcomes matter. In this article, productive capability remains a provisional interpretation of reported knowledge use and practical application, rather than a validated composite measure or a demonstrated effect on production.

Knowledge and practical skills as independent constructs

The article treats knowledge and practical skills as proposed explanatory constructs in the substantive account of productive capability. This conceptual designation does not mean that their independent statistical effects have been estimated. No regression, structural model or experimental comparison is undertaken. Production efficiency remains the context motivating the study rather than a measured dependent variable in this article.

Knowledge acquisition, experience sharing and procedural understanding describe how entrepreneurs obtain and organise know-how. Practical application and decision making describe ways in which that know-how may enter production routines. Fisheries studies concerning stewardship, situated knowledge and adaptive capacity support examining these processes in context, but their different outcomes do not validate production-efficiency relationships in the present sample (Scalisi et al., 2024; N'Guetta, 2025; Yamin et al., 2025).

Knowledge and practical skills may overlap in participants' accounts without being interchangeable. The analysis therefore preserves co-coding and examines the meaning of extracts rather than adding overlapping frequencies or assuming that a single agreement score measures competence. Separate operationalisation of knowledge and skills requires additional content assessment and evidence about actual task performance.

Research on knowledge management in SMEs provides a broader organisational foundation. The reviews by Durst et al. (2023, 2024) map a diverse literature on how smaller firms acquire, share and use knowledge. They support examining specific knowledge processes rather than treating knowledge management as one undifferentiated activity. However, findings across SME sectors cannot determine which indicators are appropriate for small fishery enterprises. Indicator selection requires attention to the tasks and language of the target participants.

Individual SME studies also require careful interpretation. Obeso et al. (2020) examine knowledge-management processes, organisational learning and performance in Spanish firms. Dahinine et al. (2023) investigate knowledge management and firm performance among Algerian food-and-beverage SMEs. Bawono et al. (2022) offer a conceptual account linking knowledge-management capability and problem-solving skills with organisational performance. These studies provide empirical and conceptual reasons to examine knowledge use, but neither their additional constructs nor their performance relationships are imported into the present model. This paper retains knowledge and practical skills as its only proposed independent constructs.

Malaysian evidence strengthens the contextual relevance of knowledge transfer. Rashid et al. (2024) examine community engagement and knowledge transfer among Setiu fishermen in Terengganu. Kamsi et al. (2025) consider livelihood capitals among small-scale fishermen in Malaysia, including human-capital dimensions. Yamin et al. (2025) provide a further local account of traditional knowledge and adaptation. These studies support attention to learning and experience in Malaysian fisheries, while their interventions, sampling and outcomes differ from the present research. Their wider frameworks do not expand this article beyond knowledge and practical skills.

Practical skills concern task execution rather than understanding alone. Valle-Pereira et al. (2022) investigate behavioural variation and fishing success among artisanal fishers interacting with dolphins. Their use of observed fishing behaviour illustrates a stronger basis for examining task performance than endorsement of a general statement about skill. The particular fishing practice is context-specific, but the measurement distinction is relevant: reported ability, agreement that an ability matters, and observed competence should not be treated as equivalent indicators.

Food-safety research offers a related distinction between knowing a procedure and performing it consistently. Insfran-Rivarola et al. (2020) review training effects on food handlers' knowledge and practice. Young et al. (2020) examine single-group pre–post food-safety training evaluations, drawing attention to the evidence available from such designs. Kwoba et al. (2023) review food-safety interventions in Asian low- and middle-income countries. These reviews support assessing understanding and behaviour separately; they do not establish the hygiene competence of the entrepreneurs in this study or explain why a particular FDM statement failed consensus.

Productivity research also helps delimit the outcome. Van Nguyen and See (2023) review frontier approaches in capture-fisheries efficiency and productivity studies, while Samat et al. (2024) synthesise aquaculture technical-efficiency research. These approaches concern measured relationships between production inputs and outputs. The present study estimates no such production frontier and includes no independently measured production outcome. Consequently, conceptual treatment of knowledge and practical skills as independent constructs does not imply that their separate statistical effects have been tested.

Contextual salience, consensus and operational eligibility

Contextual salience concerns the meaning and breadth of a practice in interview accounts. Structured convergence concerns agreement on the supplied self-referential statements under the stated fuzzy rules. Operational eligibility concerns whether item identity, content and intended use are sufficiently documented. Agreement with "I know" or "I practise" is not equivalent to expert judgement that an indicator is relevant or valid (Braun & Clarke, 2023; Fetters & Tajima, 2022; Syaifullah et al., 2025).

The distinction is applied only to knowledge- and skill-related evidence. A frequently discussed practice can fail the structured criteria, and an accepted column can remain uncertain in meaning if the administered wording is not authenticated. Neither interview frequency nor a centroid rank is interpreted as a factor-importance weight.

The transition from qualitative accounts to structured statements requires an explicit distinction between interpretive meaning and measurement. Campbell et al. (2020) explain purposive sampling through research examples. Braun and Clarke (2021, 2023) and Byrne (2022) emphasise coherence between the selected thematic approach and its analytical practices. Hennink and Kaiser (2022) show that sample-size considerations depend on the study and analytical purpose. These sources inform scrutiny of the qualitative phase; they do not retrospectively certify saturation, coding reliability or analytical procedures that are absent from the available record.

The Delphi literature treats consensus as the outcome of a specified process and decision rules. Niederberger and Spranger (2020) map methodological variation in Delphi research, and Nasa et al. (2021) discuss when the method is appropriate. Both publications concern health research and are used here only to inform methodological reasoning. Landeta and Lertxundi (2024) identify quality indicators for Delphi studies.

Together, these contributions support transparent reporting of panel selection, statement development and acceptance criteria, rather than interpreting consensus as proof of empirical construct validity.

Fuzzy Delphi applications provide examples of translating judgements into structured decisions. Blasco-Blasco et al. (2025) develop a competency-based questionnaire, while Syaifullah et al. (2025) present a procedural guide in a tourism-acceptance context. Neither application validates the fisheries statements used here. Fuzzy calculations can summarise the supplied ratings, but cannot resolve ambiguous wording, establish respondent eligibility or demonstrate that a statement measures knowledge separately from practical skill.

Mixed-methods integration makes these distinctions reviewable. Fetters and Tajima (2022) discuss joint displays for integrated data collection, and Guetterman et al. (2021) review visuals representing integration. A joint display can show where interview meanings and item-level judgements converge, diverge or cannot be aligned. In this study, contextual salience concerns meaning within the qualitative corpus; structured consensus concerns the numerical acceptance rules; operational eligibility concerns whether an accepted statement has sufficiently authenticated content to support interpretation. None substitutes for the others.

The resulting research gap is specific. Recent fisheries literature establishes the relevance of experiential knowledge and learning, while SME and food-safety research distinguishes knowledge processes from practical application. What remains unresolved in this study is whether these broad accounts translate into clearly identified, agreed statements for the target entrepreneurs. Differences between successful entrepreneurs' qualitative accounts and small entrepreneurs' questionnaire ratings may reflect experience, statement framing or current practice. Without authenticated participant comparisons and administered wording, those explanations remain possibilities to investigate. The study therefore explores reported knowledge and skill use and assesses agreement, while retaining productive capability as a provisional interpretation.

Research objectives

The following objectives operationalise the aim within the study's focus on knowledge and skills. The qualitative evidence addresses reported learning and practical application; the structured phase assesses the five corresponding questionnaire columns. Selection is based on subject matter, and all five columns are assessed, including those that do not meet the acceptance criteria. No independent construct is selected solely because its items satisfy the FDM rules.

1. To explore how knowledge and practical skills are applied in production activities among small fishery entrepreneurs in Kelantan and Terengganu, Malaysia.

2. To assess the extent of agreement among small fishery entrepreneurs on knowledge- and skill-related statements using the Fuzzy Delphi Method and integrate these findings with the qualitative evidence.

METHODS

Design and study setting

The study uses a sequential exploratory mixed-methods design in Kelantan and Terengganu, Malaysia. Qualitative accounts informed a broader questionnaire, of which this article analyses only the five columns provisionally associated with knowledge and skills. A joint display integrates related accounts and statement-level results (Fetters & Tajima, 2022; Guetterman et al., 2021). The scope comprises reported practices and structured agreement; causal productivity effects and a complete efficiency index are not estimated.

Participant recruitment and evidence coverage

Purposive sampling sought participants with direct knowledge of fisheries enterprises, production activities and relevant institutional or academic contexts (Campbell et al., 2020). The doctoral record describes identification through relevant networks, screening for relevance, voluntary invitation and informed consent.

The planned qualitative sample comprised ten participants, whereas the available archive contained eleven anonymised participant interview documents, identified as P1–P11. All eleven documents were retained for analysis.

The eleven interview records represent eleven distinct participants from Kelantan and Terengganu, as confirmed by the researcher. The reported qualitative sample includes successful entrepreneurs and representatives of fisheries and entrepreneurship-support organisations. The questionnaire phase targeted small fishery entrepreneurs. Enterprise size and business success describe different characteristics and are not mutually exclusive categories. Documented success criteria, participant-level profiles, fieldwork dates, interview durations and original-language or translation records are not available for independent appraisal. The design therefore does not establish a controlled comparison between successful and unsuccessful entrepreneurs.

The supplied workbook contains 32 numbered response rows. All 32 rows are included in the present calculations. The workbook contains no participant-level state, role, experience or eligibility fields, so state distribution and experience-based eligibility cannot be verified from this matrix. The small-entrepreneur designation follows the study description; the identity and eligibility of each of the 32 respondents require linkage to the recruitment register. Overlap with the interview participants is not established. Identical answer profiles occur for rows 8 and 9 and for rows 12 and 13 (worksheet rows 21–22 and 25–26). They are retained because identical answers alone do not identify duplicate people.

The questionnaire screens respondents for current operation of a fish-catching, processing or selling business and asks how many years the business has operated. It also requests business activity, number of employees, revenue range, age, gender and education. These questions document the intended screening and profiling procedures, but completed responses are needed to apply an experience threshold or a definition of a small enterprise. The supplied matrix alone cannot establish whether either criterion is met.

Qualitative procedure and coding

The doctoral record describes a semi-structured interview guide covering experience, enterprise practices, production-related conditions, clarification and practical examples. A three-person pre-interview review addressed clarity and sequencing; its feedback was not treated as substantive research findings. Participant documents were organised in ATLAS.ti and analysed through familiarisation, descriptive first-level coding, consolidation into broader categories and cross-document comparison. The literature supplied sensitising concepts, while the accounts could qualify or challenge them. The procedure is reported as a descriptive and interpretive coding approach; methodological labels alone do not establish analytical quality (Braun & Clarke, 2023).

The “Knowledge management” code contains 27 coded references across eleven participant documents. “Labour Skill” appears in six Quotation Manager entries, several of which are co-coded with knowledge-related passages. These entries inform the interpretation of practical skills and are not added to the 27 references as independent observations. No separate count of document coverage is reported for skills. Only these two qualitative domains are analysed in this article.

Document coverage and coded-reference frequencies describe the analysed corpus; neither represents a population proportion, effect size or importance weight. The reproduced quotations were checked against the available ATLAS.ti Quotation Manager export and retain the corresponding participant identifiers and passage positions. The export records quotation content and code assignments, including co-coded passages, supporting traceability. It does not independently establish transcription or translation procedures, analyst roles, reflexive decisions or a systematic negative-case audit. These remain limitations of independent appraisal; no unverified reliability coefficients or saturation claims are made (Braun & Clarke, 2023).

FDM scale, calculations and decision rules

The quantitative source is FDM_Fishery Result.xlsx, worksheet EPF Sect.1, range C14:G45. It contains 32 response rows and five knowledge-related columns, yielding 160 complete integer ratings from 1 to 5. Selection follows this article's knowledge-and-skills scope: the supplied questionnaire groups these five items under Knowledge Management. Other domains and the separate production-efficiency section are not analysed. The workbook contains 37 numbered columns and retains unrelated template headings. Calculations reproduce the five columns' mean distances, within-threshold counts and centroids, but questionnaire-version linkage and respondent eligibility require source-register confirmation. No additional Delphi round was conducted.

Table 2. Five-point response scale and fuzzy conversion

Rating	Agreement label	Triangular fuzzy number
1	Strongly disagree	(0.0, 0.0, 0.2)
2	Disagree	(0.0, 0.2, 0.4)
3	Moderately agree	(0.2, 0.4, 0.6)
4	Agree	(0.4, 0.6, 0.8)
5	Strongly agree	(0.6, 0.8, 1.0)

Source: Five-point numerical mapping in the supplied workbook. The questionnaire requests agreement on a 1–5 scale but the supplied copy does not display a complete set of verbal anchors. Labels shown here follow the prior study description and require confirmation against the administered form (Syaifullah et al., 2025).

FDM is retained as the study's stated analytical procedure, but the available record documents one supplied rating matrix. The analysis is therefore reported as a single-round fuzzy assessment of agreement, without claiming iterative Delphi feedback or validated expert indicator selection. The original numerical rules are retained for reproducibility.

Let j index the five selected knowledge-related columns and k the K = 32 response rows. Each rating maps to $\tilde{x}_{jk} = (l_{jk}, m_{jk}, u_{jk})$. The item-level collective components L_j, M_j and U_j are the arithmetic means across rows. The vertex distance and its mean are:

$$d_{jk} = \sqrt{\{[(l_{jk} - L_j)^2 + (m_{jk} - M_j)^2 + (u_{jk} - U_j)^2] / 3\}}; \quad \bar{d}_j = (1/K)\, \Sigma_k\, d_{jk}.$$

Consensus is $C_j = (100/K)\, \Sigma_k\, I(d_{jk} \leq 0.20)$, with I equal to one when the condition holds and zero otherwise. The centroid is $A_j = (L_j + M_j + U_j)/3$. Acceptance requires $\bar{d}_j \leq 0.20$, $C_j \geq 75\%$ and $A_j \geq 0.50$ simultaneously. At K = 32, at least 24 rows must be within the individual distance threshold. Decisions use unrounded calculations; displayed values use four decimal places. These are selection rules, not tests of statistical significance or causal influence. The fuzzy mappings for ratings 1–5 are (0,0,0.2), (0,0.2,0.4), (0.2,0.4,0.6), (0.4,0.6,0.8) and (0.6,0.8,1.0). Distances and centroids depend only on the ratings for each assessed item, so restricting the paper to five columns does not alter their calculations. All 32 supplied rows are retained, including the two identical-profile pairs described in Section 3.2. No inference about the number of eligible distinct participants is made without the recruitment register.

Integrity review and integration

The supplied Questionaire.docx contains five numbered statements under Knowledge Management. Their sequence agrees with the available content-validity form: basic records, new techniques, processing and hygiene SOPs, experience sharing, and data analysis for decisions. This provides documentary support for the crosswalk and supersedes the earlier dictionary's inconsistent SOP label. However, neither document alone proves which version generated workbook columns C–G. Table 5 reproduces the English wording and distinguishes documented thematic correspondence from unverified item-development provenance.

Items 1 and 3 concern reported knowledge; Items 2 and 4 concern reported practices; Item 5 concerns perceived analytical ability. This classification interprets the wording and does not constitute a retrospectively validated subscale structure. All five statements remain in their original block and retain their original numbers. The accompanying instructions ask respondents to indicate agreement based on their experience. No separate rating of indicator relevance, adequacy as judged by experts or content validity is documented. Accordingly, "accepted" denotes satisfaction of the stated fuzzy rules for these self-reports, rather than acceptance of an operational capability indicator. Centroids are not converted into factor-importance weights. The documentary review follows the numerical analysis and compares the questionnaire, content-validity form and workbook. Available records do not establish reviewer identities, original review dates, a complete decision log or prespecified review criteria. It is presented as a post-analysis safeguard, not independent validation. The joint display links checked interview extracts, questionnaire wording and item-level results; thematic correspondence is not evidence that a particular extract directly generated an item (Fetters & Tajima, 2022; Guetterman et al., 2021).

Ethical considerations

Participation was voluntary and based on informed consent. The doctoral record states that participants were informed of the study purpose, confidentiality arrangements and right to decline or withdraw; analytical identifiers were anonymised and identifying information was stored separately. The approving committee, institutional approval reference and date must be confirmed from the institutional ethics record before submission.

Conflict of interest: [Authors to confirm their conflict-of-interest declaration before submission.]

Data availability

The focused FDM calculations use the researcher-supplied workbook FDM_Fishery Result.xlsx, worksheet EPF Sect.1, range C14:G45. Item-level results are reported in Table 4. Quotations were checked against the supplied Quotation Manager export. Participant records and source workbooks have not been deposited publicly. The authors must confirm data custody, consent-based restrictions and permissible access arrangements before submission; access on request is not promised.

RESULT

Knowledge and practical skills in the qualitative accounts

Knowledge management was recorded in all eleven participant documents, with 27 coded references. Six partly co-coded Labour Skill entries concern practical application and inform the skills interpretation. Table 3 separates the two evidence streams without summing overlapping entries. These frequencies describe the analysed corpus; they do not establish effect size, population prevalence or the independent contribution of either construct.

Table 3. Qualitative evidence for knowledge and practical skills

Qualitative domain	Evidence count	Interpretation
Knowledge management	27 coded references across 11 documents	Breadth of reported knowledge-related experience
Labour Skill	6 Quotation Manager entries, partly co-coded	Practical application evidence; not added as independent references

Source: Original CDT and Quotation Manager analytical record. The six Labour Skill entries are partly co-coded; they are not six independent participants or a separate validated skill score.

Knowledge-related passages describe learning through contact with others and the application of procedures and skills. The following extracts illustrate these accounts:

"Like when we go, sometimes we just sit and chat with people in Marang. That's right. Take knowledge, take their experience."
(Participant 2, Reference 50)

"You must strictly follow SOPs and make decisions based on data. That's how you stay competitive." (Participant 10, Reference 17)

"Skills. If he has knowledge, then he has skills. Knowledge alone without skills is useless." (Participant 3, Reference 39)

These extracts illustrate experience-based learning, procedural understanding and the perceived importance of applying knowledge through skill. They address the first research objective through participants' reported experiences. They do not provide direct observations of SOP adherence, task accuracy or production performance. Practical skills are therefore supported as a qualitative interpretation rather than an independently validated quantitative construct.

Agreement on knowledge- and skill-related statements

Three of the five selected columns satisfy all FDM rules (60.00%): Items 2, 4 and 5. Items 1 and 3 do not meet

the consensus criterion (40.00% of assessed columns). All five meet the mean-distance criterion of ≤ 0.20 and the centroid criterion of ≥ 0.50. Respondent-level consensus therefore distinguishes accepted from non-accepted columns in this focused analysis. The 160 ratings come from 32 response rows and do not represent 160 independent respondents.

Non-acceptance indicates failure to meet the specified agreement rule; it does not show that respondents considered knowledge or skills unimportant. Item 1 has 23/32 within-threshold ratings (71.875%), one fewer than required, while Item 3 has 12/32 (37.50%). Both nevertheless meet the mean-distance and centroid conditions. The contrast illustrates why an aggregate positive score cannot substitute for sufficient individual convergence.

The second objective is addressed by agreement on the five self-reports and their integration with qualitative meanings. The supplied questionnaire does not ask respondents simply whether knowledge and skills are important. Acceptance therefore describes convergence in reported circumstances, rather than expert endorsement of the five statements as measurement indicators. The focused denominator is five items; results from earlier whole-instrument analyses are not combined with this analysis.

The supplied questionnaire identifies accepted Items 2, 4 and 5 as practising new techniques, discussing experiences and analysing data for decisions. Item 3 concerns knowing SOPs for processing and hygiene and fails consensus despite $\bar{d} = 0.1818$ and $A = 0.5958$. These wording-based interpretations depend on confirmation of the questionnaire-to-workbook linkage. The result neither demonstrates hygiene competence nor establishes that respondents reject its importance.

Complete five-item FDM results

Table 4 reports every assessed column. D = mean distance ≤ 0.20; C = at least 24/32 rows within the distance threshold; A = centroid ≥ 0.50. All three are required. Descriptions follow the supplied questionnaire; their linkage to workbook columns remains conditional.

Table 4. FDM results for knowledge-related statements

Item	Questionnaire description	**Mean d**	**Within threshold**	**Centroid A**	**Failed rule**	Fuzzy decision
1	Basic record knowledge	0.1332	23/32	0.6063	C	Not accepted

2	New techniques	0.1266	26/32	0.6313	None	Accepted
3	SOP and hygiene knowledge	0.1818	Dec-32	0.5958	C	Not accepted
4	Experience sharing	0.1169	31/32	0.6833	None	Accepted
5	Data-based decisions	0.1727	24/32	0.6167	None	Accepted

Source: Recalculation from FDM_Fishery Result.xlsx, EPF Sect.1!C14:G45. Descriptions follow Questionaire.docx; the administered-version linkage remains to be confirmed. Acceptance refers to fuzzy-rule convergence on self-reports.

Centroid ranks and interpretation

Across all five columns, the descending centroid order is Item 4 (A = 0.6833), Item 2 (0.6313), Item 5 (0.6167), Item 1 (0.6063) and Item 3 (0.5958). All three accepted columns precede the two non-accepted columns, but ranking alone does not determine acceptance. Centroids describe transformed agreement ratings; they are not estimated coefficients, causal effects or independent-variable importance weights. No separate quantitative skill rank is assigned.

Cross-phase joint display

Table 5. Integration of knowledge and practical-skills evidence

Qualitative correspondence	Supplied questionnaire wording and role	Fuzzy result and interpretation
No checked extract reproduced here specifically addresses basic business records. A direct item-development link is unverified.	1. "I know the basic records to improve my business." Reported knowledge.	23/32; A = 0.6063. Not accepted. One response below the required consensus count; no inference that record keeping is unimportant.
P3 Ref. 39 links knowledge with skill generally; it does not specifically describe adoption of new techniques.	2. "I practice new techniques to improve my business." Reported practice.	26/32; A = 0.6313. Accepted. Broad correspondence with practical application; actual technique performance unobserved.
P10 Ref. 17 stresses SOP adherence. The statement instead asks about knowing processing and hygiene procedures.	3. "I know the standard operating procedures (SOPs) for processing and hygiene." Reported knowledge.	12/32; A = 0.5958. Not accepted. Thematic importance and self-reported understanding have different meanings; business-activity differences remain untested.
P2 Ref. 50 describes learning through conversation and others' experience.	4. "I have discussions to share experiences with other entrepreneurs." Reported practice.	31/32; A = 0.6833. Accepted. Direct thematic correspondence with experience sharing; the extract-to-item development history is unverified.
P10 Ref. 17 emphasises decisions based on data; this is a normative account rather than a test of analytical ability.	5. "I can analyse data and make the decisions." Perceived analytical ability.	24/32; A = 0.6167. Accepted at the consensus boundary. Thematic correspondence does not demonstrate decision accuracy.

Source: Qualitative CDT, checked Quotation Manager extracts, supplied Questionaire.docx and focused five-column calculations. The display documents thematic correspondence, not a verified quotation-to-item development history. Item numbering follows the supplied questionnaire, conditional on workbook linkage.

Boundaries of the knowledge and skills interpretation

The paper examines knowledge and practical skills as proposed independent constructs, but does not establish their separate quantitative effects. The qualitative accounts provide meanings and examples of learning and application. The five questionnaire columns provide statement-level agreement, with three meeting the acceptance criteria. Together, these sources support an exploratory interpretation, rather than two validated scales or a tested relationship with production efficiency as a dependent variable.

The five-item block combines knowledge, reported practices and perceived ability. It cannot establish separate knowledge and skill variables without further measurement work. Its mixed content is nevertheless informative for the exploratory aim: it distinguishes knowing a procedure from reporting its application. The resulting centroids remain summaries of the rated statements.

DISCUSSION

Knowledge in use and the scope of the contribution

The interviews describe knowledge through use: exchanging experience, following procedures and connecting understanding with skill. The questionnaire expresses related ideas as personal claims. Three columns converge under the fuzzy rules, corresponding in the supplied instrument to techniques, sharing and decisions. This offers a bounded account of knowledge in use, while the non-accepted statements show that broad thematic relevance does not imply uniform self-reported understanding or practice.

This interpretation is consistent with studies linking knowledge sharing to stewardship, group capabilities to participation in certification and traditional knowledge to adaptive capacity (Scalisi et al., 2024; Wiranthi et al., 2024; Yamin et al., 2025). Those studies concern different outcomes and settings. They support the plausibility of examining knowledge through practice, while leaving the production effects of the present study's indicators untested. Similarly, situated-knowledge and co-production research highlights the importance of context without establishing an enterprise production relationship (N'Guetta, 2025; Sokolova et al., 2025).

Explaining divergence between themes and item judgements

Selective convergence is the central integration finding, but the two phases ask different questions. Interview extracts describe meanings and perceived requirements; the questionnaire asks respondents to describe themselves. Differences can therefore arise without either phase invalidating the other. Experience, training, enterprise activity and wording are possible explanations, not demonstrated causes. In particular, knowing processing and hygiene SOPs may have different relevance for catching, processing and trading businesses. The questionnaire records main business activity, but those completed profiles are not linked to the analysed matrix, preventing a subgroup assessment. Small enterprise size does not imply unsuccessful operation. A success-related explanation would require defined success criteria and comparable measures across identified groups. The joint display locates the differences without attributing them to unmeasured causes (Fetters & Tajima, 2022; Guetterman et al., 2021).

Contribution to understanding knowledge and skills

The contribution is a focused distinction between understanding, reported application and demonstrated competence. Knowledge and practical skills can be conceptually distinct while appearing together in experience-based accounts. The evidence identifies candidate practices for further investigation without assigning independent statistical effects or treating self-reported understanding as proof of effective performance.

The joint display also identifies gaps in translation: the checked extracts directly illustrate experience sharing and procedural understanding, but do not independently document every item's development history. This distinction makes the contribution reviewable without portraying thematic similarity as completed content validation. Further instrument development requires explicit judgements of relevance and clarity, alongside appropriate testing of the intended measurement role (Blasco-Blasco et al., 2025).

Validation requirements before practical implementation

The immediate priorities are to link the questionnaire version and screening records to the 32-row matrix, document expertise where expert judgement is claimed, and confirm the response anchors. Section A screens for current operation of a fishery business and years in operation; Section B requests education, business activity, number of paid employees and revenue range. These fields could support eligibility assessment and contextual description, but an uncompleted questionnaire does not establish respondents' answers. Identical response profiles should be checked against source records without assuming duplication.

Revised statements should undergo cognitive interviews with target entrepreneurs and documented content review for clarity, relevance and domain coverage before renewed panel assessment. Panel expertise and occupational coverage should be reported, with decision rules specified before examining new results (Landeta & Lertxundi, 2024). A subsequent enterprise study should compare self-reports with observed SOP performance and reliable records of losses, output and input use. Validation should follow the intended measurement model: a reflective scale would require assessment of its structure and reliability, while a formative index would require justification of component coverage, direction and weighting. Independent or longitudinal testing is needed before operational scoring. Neither an internal-consistency coefficient nor FDM acceptance alone would demonstrate production efficiency (Blasco-Blasco et al., 2025; Samat et al., 2024; Van Nguyen & See, 2023).

LIMITATIONS AND FUTURE RESEARCH

The qualitative corpus comprises eleven distinct participant records confirmed by the researcher. Missing participant-level profiles and fieldwork or translation records limit independent appraisal and role-specific interpretation. The quantitative matrix contains 32 rows without linked screening or demographic responses. Eligibility, state distribution and distinct respondent identity therefore remain unverified; two identical-profile pairs are retained pending source-register checking. The cross-phase design does not support a controlled successful-versus-unsuccessful entrepreneur comparison.

The supplied questionnaire clarifies the five item wordings and their order, but its correspondence to the analysed workbook remains to be confirmed. Complete verbal response anchors and completed content-review records are unavailable. Self-referential wording limits the fuzzy results to convergence in reported understanding, practice and perceived ability, rather than indicator-relevance consensus. No separate practical-skills scale or observed task assessment is present. Processing-specific wording may also vary in relevance across enterprise activities.

No construct-validity, observed-competence or production-outcome model was estimated. Knowledge and skills are designated independent constructs conceptually; the present data do not quantify their separate influence on production efficiency. Future studies should confirm participant eligibility and item wording before testing distinct measures and relationships with independent enterprise outcomes. These results do not support enterprise-efficiency ranking or assistance allocation.

CONCLUSIONS

The study examines how knowledge and skills emerge as an enterprise-level productive capability when contextual experience is considered alongside structured expert judgement. For the first objective, the interview accounts identify experience sharing, procedural understanding and the perceived need to apply knowledge through skill. For the second, three of five knowledge-related questionnaire columns satisfy the fuzzy rules across 32 supplied response rows. In the supplied questionnaire, these concern techniques,

experience sharing and data-based decisions. Because respondents rate personal statements, the structured evidence supports selective convergence in self-reports; it does not establish expert endorsement of an operational framework.

The contribution is an exploratory explanation of how broad accounts of knowledge in use align unevenly with particular reported practices and abilities. Non-acceptance of record and SOP statements does not establish rejection of their importance. Knowledge and practical skills remain the only proposed independent constructs, but their separate effects and measurement validity are untested. Productive capability is therefore a conceptual interpretation requiring participant-record reconciliation and independent practice or outcome assessment before operational use.

RECOMMENDATIONS

The qualitative findings and provisional convergence within the knowledge-related block identify experience sharing, practical learning and data-informed decision making as candidates for support initiatives to be evaluated. SOP and hygiene training remains relevant to the qualitative and conceptual account, but its effectiveness is not established by the FDM results. Pilot initiatives should specify observable tasks, obtainable production records and a defined observation period. Adherence to procedures, product losses, output and input use should be measured separately. These are proposed evaluation outcomes, not demonstrated intervention effects.

Future research should define knowledge and practical skills separately, confirm item content through cognitive interviews and documented review, and evaluate both reported understanding and observed task

performance. A subsequent study may test their relationships with production efficiency using suitable enterprise-level outcome data. Such a model should be presented as future research, rather than an effect already demonstrated by this paper.

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