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Skill Development in Current and Future Workers to Thrive in the Digital Aquaculture Industry

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Abstract: The digitisation of the agriculture industry provides an opportune context for accelerating sustainable food production. Aquaculture is among the fastest-growing agriculture sectors and is well placed to help address food supply shortages, directly contributing to the achievement of UN Sustainable Development Goal 2. However, the sector currently has inadequate digital capability and enabling conditions to thrive. Social cognitive career theory asserts that career choices and persistence are directly influenced by a person's thoughts, including their self-efficacy; therefore, the upskilling and reskilling of labour is required to build confidence in their digital capabilities and reduce turnover intentions. Consequently, this study sought to identify the key skills and needs for this workforce to transition to digitally driven ways of working. The results indicated that a range of skills and abilities that enable people to improve their digital capabilities were required. The findings are presented and discussed.

Keywords: agriculture; UN sustainable development goals; digital capability; enabling conditions; soft skills; self-efficacy; Australia

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1. Introduction

Impacting around 768 million people globally, world hunger increased by approximately ten percent in 2020 [1]. This issue is compounded by urbanisation, which is projected to result in continued population growth [1]. As food insecurity and the population continue to rise, so too does the need for sustainable access to food. As part of the international food security and nutrition agenda, the United Nations [2] developed the Sustainable Development Goals to promote sustainable agriculture and help put a stop to world hunger. Agriculture 4.0 plays a critical part in achieving these goals through the adoption of digital technologies and the digitisation of agricultural knowledge and farm work [3].

Investigations around efforts to integrate technology into farming systems and mechanise or automate human labour contributions have argued for the positive social, environmental, and economic outcomes that stem from the digital transformation of agriculture. Indeed, automation, technology, the digital transformation of farms, and a growing ag-tech industry are proposed to be central to the economic growth of the agriculture and aquaculture industry. Furthermore, Agriculture 4.0 promises the kinds of precision technology that will reduce the application of inputs, enhance decision making, and optimize yields. In this way, the digital transformation of the agriculture and aquaculture industry would also contribute to achieving UN Sustainable Development Goal 14 "Life Below Water", UN Sustainable Development Goal 15 "Life on Land", and UN Sustainable Development Goal 8 "Decent Work and Economic Growth". With the agriculture/aquaculture industry being one of the largest in the world, employing 874 million people globally and accounting for twenty-seven percent of the total labour force [4], the implications of this transformation for people who work in agriculture/aquaculture will be widespread. However, those that are extolling these benefits tend to be the ones who will gain from the rise of automation, the consequent removal of jobs/manual tasks, and the production efficiencies that can thereby be achieved, i.e., researchers, employers, and technology providers [5]. In focusing on the benefits of machine versus human labour, we argue that greater attention needs to be paid to the impacts of digital transformation and what this means for the existing agriculture/aquaculture workforce.

The conversation around the future of work in this age has moved beyond the disruption and creative destruction of jobs, towards a general acceptance that automated tasks and digital technologies are largely augmenting jobs rather than replacing them. Furthermore, histories of different technologies show that the adaptation of the produce, the infrastructure of farms, and the behaviour of people contribute to the successful integration of these machines into farming systems [6]. When specifically considering the aquaculture workforce, the changing skill requirements and need for training in relation to technology adoption has been well documented. In a study of barriers and enablers for engagement in activities designed to increase the adoption of new aquaculture technologies in Samoa, it was identified that adequate skills were not simply a supporting function but constituted an essential input for the adoption of new farming practices [7]. Skill shortages as limitations to technology adoption and the need for training to enable technology adoption in aquaculture have also been identified in other global contexts [8,9]. A recent demographic study of the EU aquaculture industry identified that the sector was dominated by males, aged 40 to 64 years old and with a low-to-medium level of education [10]. It was further noted that a "low education level makes the less educated or skilled workers most vulnerable for social changes caused by new developments" (p. 8). And yet, on-farm workforces oftentimes have their perspectives missing from the digital transformation conversation in terms of the adjustments they need to make in the form of developing new skills and capabilities, as well as the enabling capabilities that support their acceptance and adoption of new technology.

Furthermore, the social identities of farmers and the entanglement of their existing competencies and precision agriculture technologies have been shown to impact their acceptance and adoption of such technologies [11]. The integration of technology can change how farmers view themselves, as the identities associated with a 'good farmer' change. While farmers and owners have a choice over the adoption of digital technologies, their workforces have considerably less autonomy over the changes to their workplace and, consequently, the presence in them of digital tools expected to be utilised during their job performance. The risk of a work identity misalignment for workers as the digital transformation of agriculture/aquaculture workplaces occurs could lead to disengagement, especially if said workers lack the proficient digital skills required to adjust to their new identities at work [12]. It is, therefore, imperative that a contextualised understanding of the digital skills required for the successful adoption of new digital technologies is understood to support the meaningful development of existing workers. An argument for generating this knowledge within the existing workforce can also be made using a career development lens, as identifying target skills requirements and ensuring that workers feel self-efficacious in their task performance is vital for successful career transitions and the next generation's career choices.

1.1. Social Cognitive Career Theory

Social Cognitive Career Theory is a well-established framework that is useful for understanding people's career development and work experiences. Social Cognitive Career Theory asserts that career choices and persistence are directly influenced by a person's thoughts, including their self-efficacy beliefs in their ability to perform specific tasks and outcome expectations that their actions will lead to desired results [13,14]. According to this perspective, people are more likely to choose careers and persevere with jobs in which they believe that they will be efficacious in performing the work tasks required of them and that will attain them desirable outcomes. The results of a recent meta-analysis showed strong support for the above-mentioned theory and, particularly, the role of self-efficacy and outcome expectations as predictor variables that share theory-consistent relationships with career goals and actions among science, technology, engineering, and mathematics students [15].

While derived from several sources, mastery experiences are a foremost driver of self-efficacy. Mastery experiences provide the necessary conditions for a person to foster self-belief through genuine learning and practice wherein positive experiences enhance future efficacy expectancies [16]. There are also many types of outcome expectations that often manifest in physical forms. A perceived lifestyle offered by the surrounding physical environment is one key factor that can enrich a person's career experience and motivate them in their career pursuits [17]. The digital transformation of workplaces holds the potential to improve the work outcomes on offer, including work conditions and environmental sustainability outcomes. McIlveen and McDonald [18] have argued that lifestyle and conservation values' congruence are influential outcome expectations factors in the career decision-making process of individuals in relation to agricultural careers.

1.2. Skills

Recent research undertaken has indicated that competence in both digital [19] and soft skills, defined as non-technical 'core' skills for work [20], are needed in the emerging job and labour markets of the future [21]. The argument has been made that the context in which people learn these digital skills is an influential factor in how one uses specific digital technologies [22]. There is, however, a lack of literature concerned with understanding the specific digital skills required. One recently published report outlined a newly developed Agricultural Workforce Digital Capability Framework (AWDCF; [23]) consisting of six key skill areas including digital literacy, technology operation, data management, digital communication, incident management, and data monitoring analysis and interpretation.

In contrast, there is a wealth of literature focused on the soft skill needs in digital contexts, in which soft skills have been shown, in more recent years, to be important in both cultivating digital cultures [24] and working within increasingly technologically advanced workplaces [25,26]. There are many soft skills that have been identified in the scholarly literature on this topic [21,25,27,28], with the types needed differing widely across contexts and often being industry-dictated.

1.3. The Queensland Prawn Farming Context

The digital revolution of the agriculture industry [29] provides an opportune context for accelerating sustainable aquatic food production, and there is a need for workers to be skilled in digital technologies to prepare and adapt to this context [3,30]. While Australia employs a modest number of workers in the fishery and aquaculture sector, amounting to 17,000 people between 2019 and 2020 [31], recent funding, including an AUD 85 million investment by corporate seafood producers, is set to increase aquaculture production and, specifically, prawn farming in northern Queensland by 20- and 30-fold over the coming years [32,33]. Improvements including the implementation of IoT networks to enable the transition from paper-based systems of record keeping to digital systems, including the use of iPads and the operation of software for data input, analysis, and decision making for tasks including but not limited to monitoring, evaluating, and maintaining water quality, and WHS compliance can improve the efficiency and effectiveness of workforce and farm productivity. Additional digital technologies that will assist with the growth and success of the industry include but are not limited to the use of sensors combined with machine learning and augmented reality approaches to inform better decisions with regard to maintaining optimum pond conditions or digital optical counters that remove the human error that persists with manual approaches to counting larvae and animals and assists with efforts to reduce the mortality and stress of animals [34–36]. The successful transformation of prawn farms towards a digital future requires the workforce to embrace change in their roles and task performance, with the introduction of new technologies to operate.

However, the Australian aquaculture sector has been slow in the uptake of technology and, currently, has inadequate digital capabilities and enabling conditions to thrive in an increasingly digital world [23]. In particular, there are insufficient skilled workers in Australia to produce enough safe, quality, and sustainably sourced prawns to meet the growing domestic and international demand [37,38]. While skill training has been identified as a priority among Australian aquaculture industry stakeholders [37], the attraction and retention of workers in northern Australia is challenging due to the harsh environment, including high temperatures and extreme rainfall [39], and future labour shortages are expected. The industry must seek to retain and grow its existing workforce.

Applying SCCT to the aquaculture industry, a lack of positive mastery experiences, poor task self-efficacy and unfulfilled outcome expectancies may reduce aquaculture-related career goals and increase turnover among prawn farm workers. Some assume that digital natives come ready to quickly adopt and adapt to new technology, but some in the secondary and tertiary education sectors note that this is not always the case with their 'digital native' students [22]. Therefore, the upskilling and reskilling of labour is required to build confidence in their digital capabilities and reduce turnover intentions among the current and future prawn farming workforce, where possible, in people who value the lifestyle that a tropical environment such as north Queensland has to offer.

The AWDCF provides a framework for digital capability improvement, but the relevance of these capabilities to prawn farming specifically has, however, not yet been fully explored. It is vital to explore the aquaculture workforce's experiences of digital capability (or lack thereof) within the farm context. Furthermore, enabling capabilities and soft skills to meet the changing agricultural workforce's needs more broadly have been identified [23,29,40], but just one known recent report has sought to specifically understand the soft skills requirements and gaps in prawn farming. Atkinson [37] conducted interviews and focus groups with prawn workers and found that the skills required for successful prawn farming included adaptability, attention to detail, attitude, communication, coping skills, problem-solving ability, teamwork, time-management, and discipline-specific knowledge and skills. However, there was a lack of focus on the digital-enabling potential of these soft skills. Therefore, further exploration is required to understand the soft skills gaps relevant to digital technology application in prawn farms and develop the necessary training material to support the digital transformation of the sector [41].

In summary, little is known about people's experiences in preparing for and adapting to changing prawn farming work tasks with the rise of digital agriculture. There is a lack of research on the skills and enabling conditions needed to learn and apply digital technology in aquaculture, particularly those with a focus of on-farm workforce perspectives. Even fewer publications have focused specifically on prawn farm workers within the Australian aquaculture sector. Therefore, this study sought to identify the key skills and needs for the workforce to thrive as prawn farming workplaces proceed through a transition to digitally driven ways of working. The following questions were used to guide this research: How does the prawn farming workforce experience digital capability (or lack thereof) in the farm context? What skills and capabilities are needed for the digital transformation of the aquaculture industry? The subsequent sections of this article outline the research method and findings of this project.

2. Materials and Methods

Convenience sampling was used to recruit members of the Australian Prawn Farming Association to participate in semi-structured interviews. The final sample consisted of thirteen participants (male n = 10; female n = 3) from four Queensland farms, which included corporate, large, and smaller family-owned operations. The participants indicated that they held a variety of roles, including farm hand/labourer, assistant manager, research and development technician, senior technician, administrator, operations manager, database developer, and business owner. This was deemed to be an adequate representation of the industry, which is small, consisting of approximately 15 prawn farming businesses which included family farms and corporate operations [42]. Data were collected through individual semi-structured interviews conducted by two research team members in the context of a larger research project that was seeking to identify and address skill gaps for the aquaculture workforce more broadly. Participation was voluntary, and the participants were informed of their right to withdraw without penalties. Verbal consent was systematically obtained and recorded at the start of each interview using a verbal consent script. The interviews were approximately 45 min in length and completed using the Zoom (version 5.3.0) video conferencing platform.

Interview schedules were developed to guide the interviewers in gathering data about employer and employee attitudes and experiences of the current use and future needs of digital technology in aquaculture businesses. These schedules included questions about learning at work, digital capability, and adaptability. The completed interviews were transcribed using the Otter.ai speech-to-text transcription service, and the transcripts were proofread for obvious errors. Data analysis was performed using the NVivo 20 computer-assisted qualitative data analysis software.

Thematic analysis was used to analyse the interview data. A deductive approach was applied, which involved the pre-selection of themes based on existing literature, including the recently developed AWDCF [23] and broader literature focused on soft skills. Themes were inputted into NVivo, and large 'chunks' of data were then coded into themes in a systematic manner. Word frequency and text search functions were then used to help inform the development of codes to contextualise the pre-determined themes in the aquaculture sector and its prawn farming workforce. There were then several iterative phases of data analysis during which the codes were generated, interrogated, and altered.

3. Results

3.1. Digital Capabilities

3.1.1. Technology Operation

The participants reported that workers required a number of digital capabilities to successfully perform their role. These digital capabilities differed across roles: "Again, that depends whether it's an operational type of role, or technical role, I'd say it's more applicable for a technical role" (participant J). The participants indicated that seasonal and entry-level employees required foundational and/or developing levels of knowledge and skills regarding tablets/iPads, smartphones, and spreadsheet software such as Microsoft Excel or Google Sheets. The participants also stated that specific capabilities were important for supervisor- and management-level employees to possess, including computing knowledge and skills as well as software and device troubleshooting.

3.1.2. Data Monitoring, Analysis, and Interpretation

The participants indicated that technology was used for various reasons, including data monitoring, analysis, and interpretation. While data monitoring appeared to predominantly be performed by seasonal and entry-level employees using tablets or iPads, advanced data analysis was generally performed using formulas and spreadsheet software such as Microsoft Excel on computers and interpreted by supervisor- and management-level employees.

There was a clear distinction in the specific data monitoring and analysis knowledge and skills required in the various workforce segments. This distinction was explained by participant K: "Yeah. Certainly the, our [type] Technicians, and Managers, and even a lot of the other workers on farm, really do need to have at least a basic, if you're just a worker, understanding of Excel. That's the spreadsheet platform we use. Our Managers and Supervisors need to have, you know, an intermediate or advanced level knowledge . . . Basic is just like data entry, data collection, that kind of stuff. Our Senior Technicians and Supervisors need to be able to analyse lots of data that we collect. So yeah, really everything from, you know, writing formulas, creating formulas, using pivot tables, just a lot of stuff used with data analysis".

3.1.3. Digital Literacy

Overwhelmingly, the participants stated that their digital literacy development occurred through on-the-job training. Participant G reported the following: "So but yeah, honestly, I do not have a computer at home. I've learnt what I've learnt here is through [my employer]". This indicates that some employees have limited exposure to and practice using current relevant technology in their personal lives. Workers who expressed a proclivity toward personal learning and mastery also indicated that they acquired digital knowledge and skills from other informal sources such as LinkedIn, the academic literature on the subject, industry magazines, and Google more generally. Additionally, digital literacy was developed through formal registered training organisations or university studies. The participants in managerial positions reported that their team members would either be provided shortened versions of on-the-job training or undertake certificate-level training privately.

3.1.4. Incident Management

The participants indicated that automated sensors and in-house developed applications were implemented to assist them in managing workplace incidents that could not always be prevented. Sensors, for example, were used to monitor dissolved oxygen levels in the water. While oxygen level issues could not always be prevented, the impacts could be minimised if identified in a timely manner. Therefore, sensors had an integral role in live data monitoring in Queensland prawn farms.

Participant D described the use of sensors in oxygen level incident management as follows: "we've got a boom that comes down, we've got sensors on there, it actually measures the dissolved oxygen levels, which is just oxygen in the water. And it also measures your pH levels in the water, and the temperature of the water ... But as far as oxygen levels go, yes, we can rectify that".

3.1.5. Digital Communication

The final digital capability discussed by the participants was digital communication, undertaken in the form of emails and social media, and workers needed to have foundational and/or developing levels of knowledge and skills of these platforms. Social media and marketing were not frequent topics of focus in the participants' interviews, although emails appeared to be an area of current skill deficit among some new employees attracted to prawn farming. Participant J said that this was an area for which new staff identified to have deficits would receive training in: "What I will say from [aquaculture industry] is we took people from the farm, who some of them didn't have a lot of computer experience, but with on-the-job training and guidance they were able to learn that. And I imagine if we find gaps like that here, we'll just apply the same training principles, like we have people in [aquaculture industry] that hadn't, you know, sent an email before. And then they were working in the [place] and they were having to send emails daily, and that was a big adjustment for them, yeah, gave them, you know, gave them something new to do..." (Participant J).

3.2. Enabling Capabilities (Soft Skills)

The participants indicated that several soft skills are required to enable individuals to develop, adopt, and operate digital technology in the Australian aquaculture industry. These include the following: adaptability; collaboration; problem solving; critical thinking; willingness to continuously learn; and strategic planning.

3.2.1. Adaptability

The participants reported that adaptability was a quality that enables individuals to adjust to operating existing digital technologies and adopting emerging technologies relevant to the Australian aquaculture industry. Things are not standardised across the industry; therefore, the participants indicated that it was desirable for one to be able to adapt and upskill in the different digital technologies used for the same purpose across different aquaculture businesses. Adaptable individuals were also described as being capable of responding flexibly to advances in research and development that impacted aquaculture businesses and processes' efficiency, such as automatic feeding technologies and smart glasses. Rigidity, however, was found to hinder businesses' transformation and the digitisation of even simple manual tasks. Participant B stated, for example, that some of their seasonal employees were resistant to an easy-to-use timesheet application that would save time by automatically calculating the number of hours worked: "no, nup (sic), not gonna (sic) to try and my phone cannot support it".

3.2.2. Collaboration

The participants indicated that collaboration was required to explore, develop, and operate digital technologies that may transform Australian aquaculture. Collaborations with other employees, education providers, and professional associations were all reportedly informative and productive relationships to foster. Participant A, for example, said the following: "We have five probes that were live, collecting data live in five ponds over a couple of seasons, and [another organisation] was able to develop algorithms that enable us to predict crashes in Dissolved Oxygen, which is very important for us". A lack of collaboration between workers across businesses was, however, noted as a hinderance to the exploration of emerging technologies that may have improved businesses and processes' efficiencies. Participant F stated the following: "every agriculture sector I've ever really had any experience in, like it's, it's very much a hush, hush, this is the way we do it, no one else can know, trade-secret, sort of thing".

3.2.3. Problem-Solving

Problem-solving skills were considered to be helpful for the technological transformation of the aquaculture industry. The participants indicated that these skills were required to find potential applications of existing and emerging technology to solve inefficiencies and troubleshoot issues encountered with the implemented products. Participant M said that "There's also the [smart glasses], the augmented reality that they've been trying to push too, but I think that's a little bit more difficult . . . even voice recognition is hard with the wind blowing behind you. I think it's definitely a thing for the future because you could have a technician out in the field looking at a problem in a pond and a manager sitting somewhere that could, or a consultant sitting somewhere saying you've got this problem". Neglecting to explore solutions to problems leads to a limited uptake of potentially useful innovative technology. Participant K said that they "haven't put a lot into that traceability [software] side of things yet, because I guess we just don't understand how that works. But um, . . . yeah, I know, there's got to be a better system for us tracking, tracking the boxes we put on pallets".

3.2.4. Critical Thinking

The participants indicated that an ability to analyse a situation and make an informed judgement about the best course of action was valuable for the successful adoption of technology in the aquaculture industry. The purpose of technology adoption is to create a more resilient and profitable industry; therefore, critical thinking is required to ascertain which products will help one achieve this objective. This form of analytical thinking is illustrated by the following quote: "whatever we can do to, you know, lower that or, you know, increase that profit margin on any farm. I know, specifically, with [the aquaculture sector] our biggest three are labour, feed and electricity. So, you know, any way that we can reduce a combination of those (sic) three of them . . . would definitely be the things that the [aquaculture sector] would be interested in" (participant C). The adoption of digital technology without the careful consideration of whether it is suited to the purpose at hand could lead to increased costs and losses. Participant L explained the costs associated with the implementation of even basic mobile devices for data collection and the potential for product failure or loss, "I'm yet to decide on a particular [tablet] brand and model because harsh environments like this are going to be very demanding ... you look at the costs, etc, and then we have to have the reliability in the handset because these guys are not gentle when they get out into ponds".

An ability to think critically and apply existing knowledge from other industries to aquaculture also enables the development of new technology. This is evidenced by the following excerpt: "I was a [employee] at the local [agriculture business] and I did my Cert III as a Laboratory Technician with them ... after getting into [aquaculture] and saw what they were running on, I kind of freaked out a little bit and said, 'what is this?' And then I could see the real need for technology" (participant L). Failure to use or recognise the applicability of existing knowledge leads to its delayed development and adoption. This is captured in the following quote: "we got [them] out there, and ... we shifted [them] around a little bit. And then, then we realised [they] had this IT background, and [they were] providing suggestions on making things better, so we've directed [them] in that path and haven't looked back" (participant M).

3.2.5. Willingness to Continuously Learn

Continuous learning is required in the Australian aquaculture industry to operate and adopt digital technologies. The participants indicated that a willingness to learn was an asset that helped to enable the implementation of existing and emerging digital technology in aquaculture businesses. Participant G demonstrated a willingness to learn how to operate existing spreadsheet software to perform the required calculations and troubleshoot errors that would occur at work: "I'd like to be more confident in being able to know where to go to troubleshoot when things happen ... You know, and just, and spreadsheets and the formulas. I've never done the spreadsheet. I'd love to know more into that too". Reluctance to learn about emerging technology was described as a barrier to digital technology adoption. This is captured in the following quote: "at the moment, we are, you know, trying to excel with some more that are less inclined, less curious on the farm, and that's just, yeah, the climate that we're currently dealing with" (participant C).

3.2.6. Strategic Planning

Strategic planning is helpful to advancing the adoption of emerging technologies. The participants stated that new technologies would often have issues that could be overcome through ongoing programmes of research and development. Participant H explained the time, research, and development required to create reliable automatic feeding technologies: "probably the biggest thing that's really taking traction in the industry at the moment is automatic feeding, because it's probably the most laborious sort of task ... it's been a fair bit of development over the last 10 years, and now they've got a product that's, you know, pretty reliable, that's, you know, really taking off in the industry". Planning is also required by a manager, team leader, or supervisor at an individual business level to successfully implement new technologies once they have been developed. The participants indicated the factors that needed to be considered, including the return-on-investment measure, business resources, employee training, and any other support which may have been required. Participant C described the trials involved in selecting a company to support the planned implementation of automatic feeding technology: "we trialled them ... and then afterwards, you know, we made a decision to go with [a specific automatic feeding company], and you know, continue to meet with them". A lack of preparation was described as leading to the continued practice of outdated processes, delays in digital technology adoption, and poor troubleshooting of technological issues. Participant B reported that software that they had implemented in the past "stopped working or it didn't work that well, so ... we have to manually write it down or manually put the data entry in the computer".

4. Discussion

The current research found digital capability to be of increasing importance to the prawn farming industry and that the workplace was a vital source of support in developing digital capability skills. Furthermore, this research identified a range of soft skills and abilities that enable people to improve their digital capability and engage in activities that lead to the digital transformation of prawn farming businesses.

For the participants, the work context, the prawn farm, was central to employees' experience of digital capability. For some, this was the only context in which they had used a computer. Furthermore, the skills developed for technology operation and digital literacy were generated through both on-the-job mastery experiences and formal accredited training provided to employees through their workplace. Capabilities involving digital communication use and digital data collection tools were required for seasonal and entry-level workforce, with the levels of proficiency increasing as the job task responsibilities expanded for technicians, supervisors, and managers. The differentiation in the skills required by the different workforce segments indicated that a greater digital proficiency was required as careers progressed. This means that digital capability is a necessary factor for individuals to aspire to and engage in development opportunities and career advancement and is, consequently, vital for the retention of employees as digital transformation occurs in the prawn farming industry [23]. For this study, the important production outcomes attached to the capable use of digital technologies that facilitated incident management informed successful task performance and, consistent with the prior literature, reinforced the behaviours of on-the-ground workforce to accept and adopt said technology through the clear demonstrability of its results [41]. For the management-level workforce who were interviewed, the value of technology to the operation of their farms resulted in seeking out specific workforce with highly technical ICT skills who could design incident management tools and an acknowledgement that digital capability was required for the entirety of their workforce.

This research found that enabling capabilities and soft skills were important for workers and that these ensure that a worker is better able to seek out and engage in mastery experiences that can bolster their self-efficacy and the skills required for developing their digital capability [13,15]. Adaptability to new ways of working was essential for employees to test out digital approaches to tasks that had previously been performed manually. Problem solving and critical thinking facilitated the engagement of people in the exploration of digital technologies and was essential in taking 'ideal' technological solutions and integrating them for practical use. A willingness to learn meant that some employees aspired to improve their digital self-efficacy and capability, while those who were not willing to do so posed challenges for the supervisors and managers trying to lead their teams through the change processes happening in the farms. Furthermore, in relation to said change processes, the skill of strategic planning was clearly linked to the digital transformation of businesses, with people acknowledging that integrating technology in a farm required an adequate preparation prior to its implementation, the ongoing dedication of effort, and the securing of technical support. A failure to have a planned strategy for technology integration meant that on-the-ground workers could defer to manual workarounds when technology failed and lost motivation to persist in using technology in the future.

Collaboration escalated digital transformation, as indicated by the participants engaged in research and development collaborations with the industry. However, it was acknowledged that, in an industry in which farms are competitors in the domestic market, there were limits to knowledge sharing across the industry, with perceptions that people would withhold knowledge about emerging technology in ways that would slow the digital advancement of the industry as a whole. The overarching leadership of the industry must work to build trust between businesses to work collaboratively to achieve the projected expansion of the industry. Digital transformation is needed to unlock the improved work conditions and sustainability gains that are vital to attracting, developing, and retaining the workforce required for this growth. Improving collaborative efforts is especially important for the support of smaller-to-medium family farms who may be slower in adopting technology, needing to wait for commercially viable and established solutions due to the economies of scale of their operations.

4.1. Theoretical Implications

Feeling confident in their ability to perform tasks using digital technology is vital for the current workforce's acceptance and effective use of technology [41]. Furthermore, digital task self-efficacy can be an important influence on career choices, as this, along with positive outcome expectations which can be improved through the adoption of digital technology, drives career interests and goal progression [15]. Whether one's career choice is to take on a role in a prawn farm or continue in their career as the role changes through digital transformation, digital task self-efficacy is vital for both the attraction and retention of the aquaculture workforce. The current research has described the tasks involved under the broader digital capability framework and provides insights into the specific skills and skill areas in which people must develop their self-efficacy to thrive in an increasingly digital context. Importantly, it has also been identified that, for some workers, the farm context is the main place in which they can access the types of technology that help them develop their digital capability and where they are given the opportunity to increase their digital task self-efficacy. The findings from the current study may prove useful in further explorations of the utility of Social Cognitive Career Theory including the impact of digital task self-efficacy on skill development, work engagement, job performance, job satisfaction, and career choices. Future research that quantitatively investigates these relationships would yield findings that are essential to an informed strategic workforce development plan for the industry.

4.2. Practical Implications

The current study is an important first step in identifying specific digital capability skills for the prawn farming industry. The contextualisation of the AWDCF was hereby shown to be necessary, as the farm context shapes the skill development of workers and, in turn, the digital capability of workers either facilitates or hinders the digital transformation efforts in the industry. The six digital capability areas were successfully used to explore the prawn farming industry workforce's experiences of digital capability and identify the areas for the development of digital self-efficacy and digital skills. Partial support for the enabling capabilities identified in the AWDCF was found with our analysis, thanks to adopting higher-conceptual descriptions of systematic factors such as process improvement or business transformation and articulating these as soft skills such as adaptability and strategic planning. The need to specify these as skills allows for workplaces to engage in the development of employee's soft skills, ensuring that the enabling capability required for digital transformation is distributed across the workforce and not only focused within decision-making structures at the management or leadership level. Indeed, the soft skills we identified as being important for digital transformation were also highlighted in Atkinson's [37] research on the general skills needed for the prawn farming workforce.

The current study's findings are limited by the use of convenience sampling, although all efforts were made to seek out participants from a range of enterprises (family farming and corporate farming) and locations across Queensland and representing a range of roles in these farming businesses. Future research is required to explore the extent of the digital and soft skill gaps and the training needs of the industry. Given the small nature of the industry, these investigations could expand on the current study's findings by conducting research with all Australian prawn farming enterprises.

5. Conclusions

Substantial research argues for the gains in productivity, efficiency, and sustainability that can be made from the digital transformation of food and fibre industries. Moving towards this potential future is vital for the achievement of the UN Sustainable Development Goals, in particular those addressing zero hunger, life on land and below water, and decent work and economic growth. However, this future can only be made possible if digital capability, which is an issue in the agriculture industry and an even bigger concern in the aquaculture sector, exists and improves. This study has examined digital capability in the Queensland prawn farming industry, focusing on the on-farm workforce perspectives which are largely missing from the existing literature. The current study found that digital capability skills are important for the workforce to adapt to their roles and embrace digital technology in their task performance. Therefore, agriculture and, especially, aquaculture need to recruit, develop, and retain a digitally capable workforce. Furthermore, our findings suggest that digital self-efficacy and soft skills are vital for workers to engage in mastery experiences that will enable the development of their digital capability. Understanding the current state of digital transformation of Queensland prawn farming and the role that digital capability plays in accelerating this is important to assist in overcoming any barriers to technology acceptance, adoption, and effective use that result from a lack of an adequately skilled workforce. The current research has shown that a shift in focus from digital skills more broadly to the specific way in which they are required in the work context is a necessary first step for businesses and employers to strategically plan interventions that will support their workforce to transition to the digital future of their work.

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