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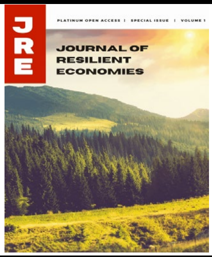

Harvesting Intelligence: Sowing Seeds of A.I. Skills in Regional, Remote and Rural Australia

Ben Archer[1]

This study examines the pervasive artificial intelligence skill shortages in regional, remote, and rural Australia, highlighting the unique challenges these areas face in effectively utilising artificial intelligence technologies. These non-urban regions are experiencing a digital divide, characterised by reduced access to key infrastructure and limited post-secondary educational opportunities. Utilising the Australian Skills Classification system, this research delineates the current skill sets required for artificial intelligence implementation, revealing pronounced deficiencies in these communities. The study finds that the lack of accessible training opportunities further exacerbates this skill gap. The research employs visual mapping analysis to illustrate the distribution of artificial intelligence-related educational opportunities and industry impacts across non-metropolitan areas. Findings indicate a significant disparity in artificial intelligence training availability, with qualifications predominantly concentrated in urban areas. The study also identifies specific skill shortages in artificial intelligence-related professions both nationally and regionally, particularly in industries such as pharmacology, social work, psychology, and transport analysis. This research underscores the urgency of bridging the digital divide to ensure equitable skill development across Australia, providing a foundation for future policy development and educational initiatives in non-urban areas.

Keywords: Reskilling, Lifelong Learning, Workforce Planning, Regional Australia, Remote Australia, Rural Australia

[1] Centre for International Trade and Business in Asia, James Cook University, Cairns, Australia, email: ben.archer@jcu.edu.au, ORCiD: 0000-0002-3215-5432

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1. Introduction

Quantifying the contribution of artificial intelligence (AI) to the Australian economy presents significant challenges due to the technology's rapidly evolving nature. Despite these difficulties in measurement, research indicates that the potential economic benefits of AI are substantial, with projections suggesting it could improve productivity by as much as 80-90% in the services sector alone in the coming decade (Productivity Commission, 2024).However, there is a concern that regional, remote and rural (RRR) communities in Australia may not fully realise these benefits, potentially exacerbating existing economic disparities between urban and non-urban areas. This study aims to address two critical questions: firstly, what is the current landscape of formal educational and training opportunities in artificial intelligence within RRR communities in Australia; and secondly, which industries in RRR areas are likely to be most significantly impacted by inadequate adaptation and adoption of AI technologies?

As AI technologies continue to advance and integrate into various sectors, it becomes increasingly crucial to examine the challenges and opportunities faced by RRR communities in adopting and leveraging AI for economic growth and societal development. The significance of this research lies in its potential to inform policy decisions and strategic initiatives aimed at fostering equitable AI adoption across Australia, thereby promoting balanced economic development between urban centres and RRR areas. By identifying gaps in AI education and potential industry vulnerabilities, this study will contribute to the development of targeted interventions that can enhance the competitiveness and resilience of RRR economies in an increasingly AI-driven global marketplace. Ultimately, addressing these questions is vital for ensuring that the transformative potential of AI benefits all Australians, regardless of their geographical location, and supports the long-term sustainability and prosperity of RRR communities.

Statement of the problem: AI skills shortages in regional, remote, and rural Australia

The unique situation of education and training opportunities in regional, remote and rural (RRR) communities plays a crucial role in shaping the potential for AI adoption and utilisation in these areas. Halsey's (2018) comprehensive review of education in RRR Australia highlighted a significant dearth of post-school education and training opportunities in these communities. This scarcity of accessible higher education and vocational training options can severely limit the development of advanced technological skills, including those necessary for effective AI implementation and management.

Educational institutions have a significant role to play in determining the skills pathways chosen by individuals in RRR communities (Archer et al., 2024). These institutions not only provide formal education but also shape aspirations and awareness of emerging technological opportunities. In the context of AI, the presence or absence of relevant courses, workshops, or industry partnerships can significantly influence whether local populations develop the expertise needed to leverage AI technologies effectively.

The confluence of these two factors – the limited availability of post-school education and the influential role of existing educational institutions – has the potential to stifle AI adoption and effective use in RRR communities. Without adequate access to specialised training in AI and related fields, RRR populations may lack the necessary skills to implement, maintain, and innovate with AI technologies. Moreover, if local educational institutions do not prioritise or have the resources to offer AI-related curricula, it may create a self-perpetuating cycle where awareness of AI's potential remains low, further hampering adoption and integration of these technologies into local economies and services.

Significance of the study

The significance of this study lies in its comprehensive examination of the existing educational and training landscape in regional, remote and rural (RRR) communities, with a specific focus on artificial intelligence (AI) and related skills development. By conducting a desktop survey of current higher education and vocational education and training institutions in RRR areas, this research will identify geographical and discipline-specific gaps in AI education and training.

Furthermore, this study will provide a foundation for postulating the potential impact of these educational gaps on effective AI usage in RRR communities. By understanding where AI education is lacking, we can better anticipate challenges in AI implementation and innovation across different regions. By comprehensively mapping and analysing AI-related educational opportunities in RRR areas, this study will contribute significantly to our understanding of the readiness of these communities to engage with and benefit from AI technologies, informing future strategies to ensure RRR communities are not left behind in the AI-driven economic landscape.

Research objectives and questions

To address the critical issues surrounding artificial intelligence education and adoption in regional, remote and rural (RRR) communities, this study will focus on two key areas of inquiry. The following research questions have been formulated to guide our investigation into the current state of AI education and its potential impact on local industries in RRR Australia:

I. What is the current landscape of formal educational and training opportunities in artificial intelligence within regional, remote and rural communities in Australia?
II. Which industries in regional, remote and rural areas are likely to be most significantly impacted by inadequate adaptation and adoption of artificial intelligence technologies?

Through addressing these questions, we will gain insights into the readiness of RRR communities to participate in and benefit from the growing AI-driven economy. By identifying gaps in AI education and potential impacts on local industries, this research will inform policymakers, educational institutions, and regional development organisations, enabling them to develop targeted strategies that ensure RRR communities are not left behind in the technological revolution.

2. Literature Review

Human Capital Theory, which posits that individuals invest in education and skills to enhance their future earning potential, takes on unique dimensions in regional, remote, and rural (RRR) communities. In these areas, the theory's application is complicated by distinct economic and social factors (Stallmann et al., 1993). Johnson and Stallman (1994) highlight how local economic conditions in resource-dependent and rural areas can significantly impact educational and career decisions. Unlike in urban centres, where diverse job markets may clearly reward higher education, rural communities often face limited job opportunities, income instability, and a prevalence of low-skill positions (Ontiveros, 2020). These conditions can create disincentives for individuals to invest in education, as the perceived returns may not justify the cost and effort. This localised perspective can lead to underinvestment in human capital, potentially perpetuating cycles of low educational attainment and economic stagnation (Halsey, 2018).

The application of Human Capital Theory in RRR contexts becomes even more complex when considering emerging technologies such AI. Denny (2019) examines Australia's economic transformation in light of the Fourth Industrial Revolution, finding that the country's educational attainment structure may be constraining its ability to innovate and diversify beyond a services-based economy. This suggests that Australia's current human capital investments may not be adequately aligned with the needs of an increasingly technology-driven economy, particularly in RRR areas. Building upon this, Cavazza et al. (2023) highlight how AI in agriculture could lead to new business models and increased productivity, potentially altering the skills and knowledge required in the sector. This underscores the growing importance of adapting human capital development strategies to meet the changing demands of technologically advancing industries in RRR communities.

The challenges faced by people in RRR communities in accessing post-school training have significant implications for the adoption and utilisation of AI in their work. These areas, despite being rich in cultural capital and natural resources, often lack the educational infrastructure available in urban centres (Halsey, 2018; Sullivan et al., 2018). Consequently, many young people from RRR areas find themselves compelled to migrate to larger towns and cities to pursue higher education or vocational training (Cook et al., 2022; A. N. Stone & Évora, 2021). This migration, while necessary for individual growth and career development, often results in a 'brain drain' phenomenon, where talented and motivated individuals leave their home communities, potentially stunting local economic growth and community development (Lofters, 2012).

The role of educational institutions in shaping the post-school outcomes of RRR youth is crucial, particularly in the context of AI skills development. Secondary schools play a vital role in preparing students for future opportunities (Archer et al., 2024), while higher education providers have recognised the need to address the underrepresentation of RRR students in universities (C. Stone et al., 2022). Various initiatives have been implemented, including 'rural hub' models for core subject areas and embedding university staff within secondary schools (Douglas et al., 2020). However, outreach programs designed to encourage students to migrate to urban settings for university study have largely been ineffective (Douglas et al., 2020), possibly due to the failure to address underlying socioeconomic disadvantages experienced by students in RRR areas.

The employment landscape in RRR areas significantly shapes post-school training decisions, including those related to AI skills acquisition. In regions experiencing economic downturns, young people often gravitate towards higher education or contemplate relocation for employment prospects (Dayaram et al., 2020). However, in areas with robust job markets, youth may be inclined to remain, particularly if they've secured part-time work during their secondary education(Dayaram et al., 2020). Vocational education and training (VET) plays a crucial role in this context, offering practical, skills-based learning with direct links to employment. Despite its potential to bridge the gap between education and industry needs, the perceived value of VET in these communities can be undermined (Brown et al., 2022). This is often due to employers' tendency to prioritise social capital and provide in-house training, sometimes overlooking the benefits of formal qualifications. Nonetheless, VET's capacity to deliver industry-specific skills, including those related to AI, remains a vital component of the post-school training ecosystem in RRR areas.

The digital divide between urban and non-urban areas in Australia further complicates the landscape of AI skills development in RRR communities. Vichie (2017) notes that as of 2014, only 75% of regional Australians had broadband internet connections, with 27% accessing via smartphone. When internet is available in rural areas, it is often slower, less reliable and more expensive than urban services. This digital divide extends beyond mere connectivity - Vichie notes that many regional users are considered 'potential transitioners' (2017, p. 31), only using digital media when clear benefits are apparent. These factors create significant barriers for rural students in accessing online learning resources, completing homework, and developing essential digital competencies for future employment in AI-related fields. As AI becomes increasingly integrated into various sectors of the economy, the lack of reliable internet access and digital literacy in rural areas may further widen the economic gap between urban and rural regions. Consequently, RRR residents risk being left behind in the AI-driven job market, potentially exacerbating existing economic disparities and limiting opportunities for rural economic growth and innovation.

3. Material and Methods

Visual mapping analysis is a methodological approach that combines spatial data processing, statistical analysis, and visual representation techniques to examine complex geographical phenomena (Manika et al., 2021). This approach involves collecting location-based data, converting addresses or coordinates into mappable points, and then analysing these points in relation to other spatial and non-spatial variables such as location of related businesses. The resulting data is then visualised through various mapping techniques, such as heat maps, cluster analysis, and thematic maps. This method allows researchers to identify spatial patterns, concentrations, and relationships that might not be apparent in traditional statistical analyses.

The visual mapping analysis approach provides an appropriate framework for addressing the research questions concerning AI in regional, remote and rural communities in Australia. For the first research question, this methodology was employed to map and analyse the distribution of formal education and training opportunities across non-metropolitan areas. By mapping the locations of educational institutions offering AI-related courses and overlaying this with population data, areas with limited access to AI education can be clearly identified. For the second research question, the sector-specific analysis techniques can be applied to industries in regional, remote and rural areas, illustrating their current distribution and concentration. This can then be combined with data on AI adoption rates or potential AI impact to visually represent which industries and geographical areas are most vulnerable to inadequate AI adaptation and adoption. The temporal aspect of this methodology also allows for tracking changes over time, providing insights into the evolving landscape of AI education and industry impact in these communities.

Data collection for this study was drawn exclusively from sources that are federally funded, either through Australian Research Council grants or via government tender. To ensure compliance with copyright regulations and to facilitate open access to research findings, only sources available under Creative Commons Attribution licences were utilised. This approach not only guarantees the reliability and authority of the data but also allows for the wider dissemination and replication of the research findings.

This methodological approach aligns well with the challenges and research objectives outlined above. The visual mapping analysis can effectively illustrate the "dearth of post-school education and training opportunities" in RRR communities highlighted by Halsey (2018), by spatially representing the distribution of AI-related educational opportunities. Furthermore, it can help quantify and visualise the potential "brain drain" phenomenon discussed, by mapping the migration patterns of skilled individuals from RRR areas to urban centres. The sector-specific analysis aspect of this methodology is particularly relevant to identifying which industries in RRR areas are most likely to be impacted by inadequate AI adoption, as mentioned in the second research question. Moreover, this approach can help visualise the digital divide between urban and non-urban areas, as discussed by Vichie (2017) and Statti and Torres (2020), by mapping broadband internet access and digital literacy levels across different regions. By providing clear, spatial representations of these complex data, this approach is well-suited for analysing and presenting findings on the geographically-specific challenges of AI education and adoption in non-metropolitan Australia.

The next stage of this study adapts the methodology developed by Archer **(2024)** to connect AI-related degree learning outcomes with specific occupations using the Australian Skills Classification. This approach involves mapping the learning outcomes from AI qualifications offered in RRR areas to the Core Competencies outlined in the Australian Skills Classification. These competencies are then linked to Occupational Skills, allowing for the identification of potential occupations relevant to RRR industries. The Australian Skills Classification was also employed to categorise the sources of qualifications, including universities and vocational training colleges. This classification system provides a standardised framework for comparing and analysing educational offerings across different institutions and regions.

By focusing on learning outcomes rather than employability experiences, this methodology is particularly suitable for emerging fields like AI. This framework enables us to identify transferable skills developed through AI-related qualifications, forecast potential occupations in non-urban settings, and highlight possible skills gaps in RRR areas. Consequently, this approach provides valuable insights into the potential impact of limited AI education offerings on various sectors in RRR communities, informing educational planning and workforce development strategies.

4. Analysis

Existing Qualifications – Visual Mapping

AI as an education field is classified as a sub-section of Computer Science by the Australian Bureau of Statistics (2001). Utilising this, two searches were undertaken to provide an overview of existing qualifications that are focussed on AI. The first search was conducted with the National Register of Training, which is the Australian Government database of Vocational Education and Training qualifications (training.gov.au). The second search was conducted through the Australian Government's Study Australia portal. Table 1 provides an overview of the qualifications in AI that are currently offered through regulated Registered Training Organisations and Higher Education Providers in Australia. Qualifications were only included where the degree title included artificial intelligence as a named element in the degree, or as a major area of study. Degrees where specialisations or minors in artificial intelligence were available are not included.

Table 1-List of Qualifications Available in Artificial Intelligence

AQF Level	Course Type	Course Title	Number of Offerings
5	Diploma	Applied Blockchain Merging Machine Learning and Artificial Intelligence (10991NAT)	2
5	Diploma	Diploma of Artificial Intelligence (AI) (11287NAT)	0
7	Bachelor	Advanced Computer Science	1
7	Bachelor	Bachelor of Artificial Intelligence	3
7	Bachelor	Arts	1
7	Bachelor	Computer Science	8
7	Bachelor	Information Technology	5
7	Bachelor	Software Engineering	2
8	Graduate Certificate	Applied Artificial Intelligence	1
8	Graduate Certificate	Artificial Intelligence & Machine Learning	2
8	Graduate Certificate	Artificial Intelligence	4
8	Graduate Certificate	Data Science and Artificial Intelligence (11097NAT)	0
8	Graduate Certificate	Foundation of Artificial Intelligence	1
8	Graduate Diploma	Artificial Intelligence	2
8	Graduate Diploma	Artificial Intelligence & Data Science	1
8	Graduate Diploma	Artificial Intelligence & Machine Learning	2
9	Master	Applied Artificial Intelligence	2
9	Master	Artificial Intelligence	9
9	Master	Artificial Intelligence & Machine Learning	1
9	Master	Commerce	1
9	Master	Computer Science	2
9	Master	Data Science & Artificial Intelligence	1
9	Master	Information Technology	5
9	Master	Machine Learning and Computer Vision	1
9	Master	Robotics & Artificial Intelligence	1
9	Master	Software Engineering	2
Total Offerings			60

The qualifications range from Diploma (AQF level 5) to Master's degrees (AQF level 9), with a total of 60 course offerings identified. Bachelor's degrees (AQF level 7) constitute the majority of undergraduate offerings, with Computer Science being the most prevalent. At the postgraduate level, there is a diverse range of Graduate Certificates and Graduate Diplomas (AQF level 8), as well as Master's degrees (AQF level 9) specifically focused on Artificial Intelligence.

Table 2-Location of Delivery of Artificial Intelligence Qualifications

AQF Level	Course Type	Mode of Delivery		Location of Provider	
5	Diploma	2	In-person	2	City
7	Bachelor	15	In-person	0	Regional, Remote, Rural Community
		5	Online	15	City
8	Graduate Certificate	5	In-person	1	Regional, Remote, Rural Community
		3	Online	6	City
8	Graduate Diploma	1	In-person	0	Regional, Remote, Rural Community
		1	Online	2	City
8	Graduate Diploma	3	In-person	0	Regional, Remote, Rural Community
		0	Online	3	City
9	Master	19	In-person	3	Regional, Remote, Rural Community
		7	Online	23	City

Table 2 illustrates the distribution of artificial intelligence-related qualifications across different AQF levels, modes of delivery, and provider locations. The majority of offerings are at the Master's level (AQF 9), with 19 in-person and 7 online programmes. Bachelor's degrees (AQF 7) follow, featuring 15 in-person and 5 online courses. Notably, there is a significant disparity in the location of providers, with the vast majority situated in city areas.

Only a small number of programmes are offered by institutions in regional, remote, or rural communities, specifically 1 Graduate Certificate, 3 Master's degrees, and no Bachelor's degrees. Figure 1 highlights the distribution of the provision of the qualifications.

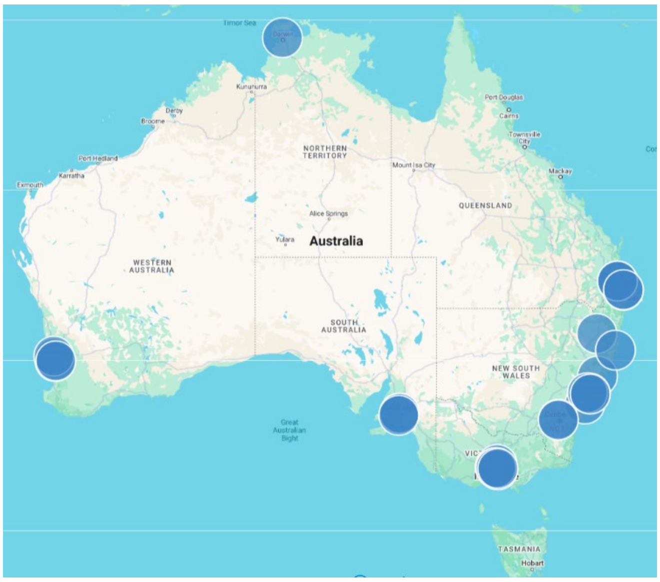

Figure 1-Visual Map of Artificial Intelligence Qualification Delivery

This centralisation of educational opportunities in AI in urban areas is further exacerbated by the challenges of limited internet connectivity. The National Audit of Mobile Coverage (Australian Government & Accenture, 2024) identifies significant gaps in wireless internet connectivity as outlined in the areas of white in Figure 2. In addition to this, the high cost of place-based internet access (Thomas et al., 2023) makes it even more challenging for people in regional, remote and rural communities to be able to train in AI. This scarcity of educational pathways can lead to a deficiency in AI skills within the local workforce, as RRR residents face additional barriers to acquiring these increasingly vital skills. Consequently, RRR communities may struggle to develop, attract, and retain professionals across industries key to te community. The potential exists that this will hinder technological adoption, innovation, and economic growth in these areas. This educational divide could further widen the digital gap between urban and RRR regions, impacting their ability to compete in an increasingly AI-driven global economy.

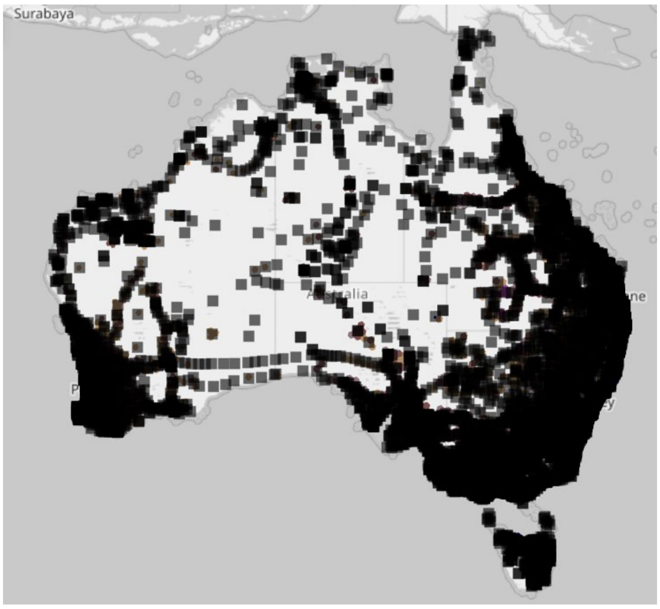

Figure 2- Overview of Mobile and Internet Connectivity Availability. Source: Thomas et. al. (2023). Used under CC BY-NC-SA 4.0

Skills from Qualifications – Link to Occupations

During the data collection phase of this study, it was discovered that approximately 40% of the institutions who offered qualifications in AI had removed their Graduate Learning Outcomes from public view; either placing them behind a login or stating they were undergoing review. To overcome this, an assumption was made that all the qualifications enabled students to gain skills in computer science as per the classification of AI as an area of study by the Australian Bureau of Statistics (2001). Secondly, the Australian Skills Classification was utilised to identify artificial intelligence skills as they currently sit within the Digital Technologies and Electronics Industry.

An examination of the Australian Skills Classification (Jobs and Skills Australia, 2023) reveals that AI usage is not categorised as a core competency. Instead, AI usage appears as a component in three distinct specialist skills: developing methods of social or economic research, identifying opportunities to apply AI to research or projects, and developing biological research methods. These specialist skills are distributed across three different skills clusters: Data analytics and databases, Performance evaluation and efficiency improvement, and Science and mathematics, respectively. This classification suggests that while AI usage is recognised as a specialised skill in specific research and innovation contexts, it is not yet considered a foundational skill applicable across all occupations in the Australian workforce.

Table 3-Specialist Tasks Involving Artificial Intelligence. Source: Australian Skills Classification (Jobs and Skills Australia, 2023)

Specialist Task	Specialist Cluster	Cluster Family	Occupations
Identify opportunities to apply artificial intelligence to research or projects	Research, evaluate or design new technologies	Performance evaluation and efficiency improvement	- ICT Business and Systems Analysts - Web Designer - Database Administrator
Develop biological research methods	Undertake biological research	Science and mathematics	- Life Scientist (General) - Neuroscientist - Pharmacologist (Non-clinical)
Develop methods of social or economic research	Undertake research and analyse data	Data, analytics, and databases	- Social Professionals - Economist - Organisational Psychologist - Sport Psychologist - Linguist - Sociologist - Transport Analyst

Table 3 outlines three specialist tasks in the Australian Skills Classification that directly relate to AI. These tasks are distributed across different specialist clusters and cluster families, namely "Performance evaluation and efficiency improvement", "Science and mathematics", and "Data, analytics, and databases". The tasks are relevant to various occupations, ranging from ICT professionals and scientists to social researchers and analysts. This classification demonstrates that AI-related skills are currently recognised primarily in research and analytical contexts across different fields, rather than as a widely applicable competency.

The National Skills Priority List (SPL) provides a comprehensive overview of occupations and geographic areas in Australia where labour demand outstrips the local supply of qualified individuals. This assessment takes into account various factors to determine a labour market rating for each occupation, both nationally and for individual states and territories, with specific attention given to regional areas outside capital cities. It's important to note that an occupation may be classified as being in shortage even if not all specialisations within that occupation are affected, and a national shortage rating does not necessarily indicate difficulty in recruitment across all geographical locations. The SPL defines a shortage as occurring when employers are unable to fill, or face considerable difficulty filling, vacancies for an occupation at current levels of remuneration and conditions, in reasonably accessible locations.

An examination of access to artificial intelligence (AI) training across Australia was conducted by combining data from Figures 2 and 3. This analysis, presented in Table 4, as featured in Appendix A, reveals several Statistical Area Level 4 (SA4) regions with limited access to AI training. These areas include NT Outback, QLD Outback, WA Outback (North and South), QLD Darling Downs, NSW Far West & Orana, South Australia Outback, and Tasmania West & North West. These regions face significant challenges in developing AI-related skills due to factors such as geographical isolation, limited educational infrastructure, and potential digital connectivity issues. The identification of these areas highlights the uneven distribution of AI training opportunities across the country, potentially exacerbating existing disparities between urban and rural areas in terms of technological adoption and workforce development.

Table 4 also presents data on skill shortages across the occupations identified in Table 3, which are associated with AI-related specialist tasks in the Australian Skills Classification. The analysis reveals national skills shortages for several professions that utilise AI-related skills, including Pharmacologists (Non-clinical), Social Professionals, Organisational Psychologists, and Sport Psychologists. These nationwide shortages suggest a broader challenge in developing and retaining professionals with AI-related skills across Australia. Additionally, Transport Analysts were found to be in shortage across all SA4 areas except Tasmania West & North West, indicating a widespread demand for this profession that intersects with AI applications.

The data in Table 4 (see Appendix A) further highlights localised shortages in specific regions. The WA Outback region faces a shortage of Linguists, while the QLD Darling Downs area experiences shortages in Life Scientists and Neuroscientists. These findings underscore the complex landscape of AI-related skill shortages across Australia, with both national and region-specific challenges in developing and maintaining a workforce capable of leveraging AI technologies effectively. The combination of limited access to AI training in certain regions and specific skill shortages presents a multifaceted challenge for policymakers, educators, and industry leaders working to ensure Australia's workforce is prepared for the increasing integration of AI across various sectors of the economy.

5. Results and Discussion

The findings reveal a significant disparity in the availability of AI training across Australia, with the majority of qualifications concentrated in urban areas. Only a small number of AI programmes are offered by institutions in RRR communities, exacerbating the challenges faced by these areas in developing AI skills. This centralisation of educational opportunities, coupled with limited internet connectivity and high costs of place-based internet access in RRR areas, creates substantial barriers for residents seeking to acquire AI skills. The Australian Skills Classification recognises AI usage primarily as a specialised skill in specific research and innovation contexts, rather than a foundational competency across all occupations. Furthermore, the National Skills Priority List identifies shortages in several AI-related professions both nationally and in specific regions, highlighting the complex landscape of AI-related skill shortages and the urgent need to address the uneven distribution of AI training opportunities across the country.

There is a need to highlight significant shortages in several key professions, irrespective of AI accessibility issues. Specifically, there is a widespread scarcity of Pharmacologists, Social Professionals (including Social Workers and Community Health

Liaisons), Organisational Psychologists, and Sport Psychologists across Australia. These shortages persist regardless of geographical location or technological advancements, indicating deep-rooted challenges in the education, recruitment, and retention of professionals in these fields. The pervasive nature of these shortages suggests that addressing them will require targeted interventions at a national level, focusing on education pathways, professional development, and workforce planning strategies.

The widespread shortage of transport analysts across nearly all SA4 areas examined in the study likely has significant implications for regional economies and infrastructure development. This scarcity may hinder efficient transportation planning, potentially leading to suboptimal logistics, increased costs, and reduced economic competitiveness in these regions. AI, if effectively implemented, could offer a partial solution to this shortage by automating certain aspects of transport analysis, such as data processing, pattern recognition, and predictive modelling. By augmenting human expertise with AI-powered tools, regions could potentially mitigate the impact of the analyst shortage, enabling more efficient transportation planning and management even with limited human resources.

The localised shortages of Linguists, Life Scientists, and Neuroscientists in Queensland Darling Downs, Outback and Western Australia's Southern Outback regions, compounded by limited AI training opportunities and restricted online access in RRR areas, pose significant challenges for the healthcare and education sectors. These constraints may severely hinder medical research, specialised care delivery, and the development of effective language programmes. The scarcity of accessible AI education and poor internet connectivity in RRR regions further exacerbates these issues, potentially widening the gap between urban and rural capabilities in these critical fields. Without adequate AI skills and reliable online access, healthcare professionals in RRR areas may struggle to leverage cutting-edge diagnostic tools and research methodologies, potentially compromising patient care and regional health outcomes. Similarly, educators may find themselves unable to implement AI-enhanced personalised learning or efficient administrative systems, potentially leading to suboptimal educational experiences and outcomes for students in these regions. This technological divide could ultimately result in a self-perpetuating cycle of skill shortages, as the lack of advanced training opportunities and limited access to AI resources may discourage professionals from seeking employment or remaining in RRR areas, further deepening the existing disparities in healthcare and education provision across Queensland.

6. Conclusions

The findings reveal a significant disparity in the availability of AI training across Australia, with qualifications predominantly concentrated in urban areas and limited offerings in RRR communities. This centralisation of educational opportunities, coupled with poor internet connectivity and high costs of access in RRR areas, creates substantial barriers for residents seeking to acquire AI skills. The Australian Skills Classification recognises AI usage primarily as a specialised skill rather than a foundational competency, while the National Skills Priority List identifies shortages in several AI-related professions both nationally and regionally. These shortages are particularly acute in industries such as pharmacology, social work, psychology, and transport analysis, irrespective of geographical location. The localised shortages of linguists, life scientists, and neuroscientists in specific RRR areas, combined with limited AI training opportunities, pose significant challenges for healthcare and education sectors in these regions. This uneven landscape of AI training opportunities and persistent skill shortages across the country highlight the urgent need for targeted interventions to address workforce development and technological adoption disparities between urban and RRR areas.

The scarcity of AI training opportunities and persistent skill shortages in RRR communities can significantly impede local economic growth and development. Limited access to AI skills and professionals hinders technological adoption and innovation across various industries, potentially reducing productivity and competitiveness in these regions. The lack of specialised expertise in fields such as transport analysis, linguistics, and life sciences may constrain the development of key sectors, including logistics, education, and healthcare, which are vital for attracting and retaining businesses and residents. Moreover, the inability to leverage AI technologies effectively could exacerbate existing economic disparities between urban and RRR areas, potentially leading to a cycle of decreased investment, reduced job opportunities, and outward migration of skilled workers, further weakening the economic resilience of RRR communities.

A significant limitation in this study sits within the Australian Skills Classification. The classification appears to be lagging behind current trends in AI integration within the economy. Despite the growing importance of AI across various sectors, as highlighted by recent research, the Classification does not recognise AI usage as a core competency. Instead, AI-related skills are limited to only three specialist skills, each situated in different skills clusters related to research and innovation. This narrow categorisation of AI skills contrasts sharply with the broader impact of AI on the Australian economy, as noted in studies by Denny (2019) and Cavazza et al. (2023). Furthermore, the Classification's current structure may not adequately reflect the evolving skill requirements in regional, remote, and rural areas, where AI adoption could potentially bridge existing digital divides and create new economic opportunities. This discrepancy suggests that the Australian Skills Classification may need to be updated to better reflect the growing significance of AI skills across a wider range of occupations and sectors.

Future research could explore the potential of implementing short, practical AI microcredentials tailored specifically for RRR communities. This action research project could involve collaborating with local industries, educational institutions, and community organisations to design and deliver targeted, accessible AI training modules that address immediate skill gaps and industry needs. The study could assess the effectiveness of various delivery methods, such as utilising the Regional University Study Hub network in delivering short in-person training in AI. By evaluating the impact of these microcredentials on local workforce capabilities, technological adoption, and economic outcomes, the research could provide valuable insights into scalable strategies for enhancing AI skills and fostering innovation in RRR areas.

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Appendix A

Table 4- Skill Shortage Status of Occupations that Involve Skills Directly Related to AI. Source: National Skills Priority List (Jobs and Skills Australia, 2023)

Occupations	NT Outback	QLD Outback	WA Outback (North)	WA Outback (South)	QLD Darling Downs	NSW Far West & Orana	South Australia Outback	Tasmania West & North West
ICT Business and Systems Analysts	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage
Web Designer	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage
Database Administrator	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage
Life Scientist	No shortage	No shortage	No shortage	No shortage	Localised shortage	No shortage	No shortage	No shortage
Neuroscientist	No shortage	No shortage	No shortage	No shortage	Localised shortage	No shortage	No shortage	No shortage
Pharmacologist (Non-clinical)	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage
Social Professionals	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage
Economist	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage
Organisational Psychologist	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage
Sport Psychologist	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage	National shortage
Linguist	No shortage	No shortage	Localised shortage	No shortage	No shortage	No shortage	No shortage	No shortage
Sociologist	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage	No shortage
Transport Analyst	Localised shortage	Localised shortage	Localised shortage	Localised shortage	Localised shortage	Localised shortage	Localised shortage	No shortage