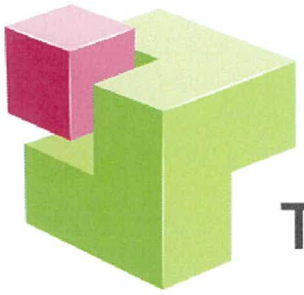

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Improving Teacher Preparation for Technologies Education in Australia

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Abstract

This study critically examines how Initial Teacher Education (ITE) programmes in Australia prepare pre-service teachers to teach technologies subjects and teaching areas. Despite the national curriculum's introduction in 2015, many ITE programmes remain misaligned with its objectives, leaving future educators underprepared to teach essential technological skills. Employing qualitative document analysis of programme structures and course profiles from 41 Australian universities offering ITE programmes, the research identifies significant inconsistencies and gaps in technologies education across states and territories. Key barriers include the application and inflexibility of programme accreditations, hampering the responsiveness of ITE programmes to rapid technological advancements like artificial intelligence, computational thinking, and modern manufacturing techniques. This is compounded by a mismatch between advocacy for technologies education and its practical implementation in ITE curricula. The study underscores the broader implications of these deficiencies for the education system and Australia's future STEM workforce. Recommendations advocate for strengthening accreditation processes to allow greater consistency and adaptability, ensuring minimum curriculum coverage for technologies education, increasing specialisation opportunities in secondary technologies, providing better career guidance for prospective teachers, and promoting national consistency in technologies education. Addressing these issues is imperative for equipping teachers to effectively educate students in a technology-driven world and for sustaining Australia's competitiveness in global STEM industries.

Keywords

Initial Teacher Education (ITE), Technologies Curriculum, Design and Technologies, Digital Technologies, ICT/Digital Literacy (ICT/DL), teacher accreditation, educational technology

Introduction

As the world becomes increasingly reliant on technology, the role of schools in preparing students for this future is more critical than ever. Central to this preparation is the effectiveness of technologies education, which aims to foster students' skills in both Design and Technologies and Digital Technologies (ACARA, 2015). The ability of schools to meet these objectives, however, hinges on how well Initial Teacher Education (ITE) programmes equip future educators with the necessary skills and knowledge to teach these subjects. This study investigates the extent to which Australian ITE programmes prepare pre-service teachers to deliver the technologies curriculum and technologies teaching areas, highlighting significant gaps, state-based disparities, and the broader implications for the education system and future workforce.

The introduction of the Australian Curriculum *Technologies Learning Area* in 2015 was a milestone in Australian education policy, reflecting the growing importance of digital literacy, design thinking, computational thinking, and problem-solving in an increasingly interconnected world. Yet, despite this curriculum framework, many ITE programmes are not aligned with its objectives, leaving future teachers underprepared to teach vital technological skills. This is concerning given the rapid advancements in fields such as artificial intelligence (AI), robotics, advanced manufacturing techniques, and farm automation, which demand a workforce capable of both understanding and applying these emerging technologies. If teachers are not adequately trained in these areas, the risk of a skills gap developing between what students are taught and what industry requires is considerable (Zagami, 2022).

The current five-year accreditation cycle for ITE programmes presents a significant challenge in ensuring that programmes remain up to date with evolving technologies. The rigid nature of this cycle means that any delay in addressing emerging educational needs, such as computational thinking (CT) or Generative AI, can result in a decade or more of outdated ITE curricula and missed opportunities to prepare teachers and their students for the realities of the modern world. Compounding this issue are regional disparities across Australia, where the availability of technologies education in ITE programmes varies significantly between states and territories, exacerbating inequality in teacher preparation.

While previous studies have explored the scope of technologies education in Australian schools (Williams & Keirl, 2001) and ITE programmes (Blannin et al., 2022), this study is motivated by a growing recognition that inconsistencies in ITE programmes have far-reaching consequences, not only for the successful implementation of technologies education in schools but also for the broader technological workforce pipeline. With industry looking to schools to develop future talent in STEM fields, it is crucial that ITE programmes prepare teachers who can effectively engage students in technologies education. Unfortunately, current data suggests that many ITE programmes fail to meet this need, with 27% of undergraduate (UG) and 10% of postgraduate (PG) programmes offering no pathways for learning to teach any secondary technologies subjects and even fewer addressing specialised areas such as computer science or industrial technologies.

The aim of this study is to examine the gaps in technologies education within Australian ITE programmes, explore the systemic factors contributing to these deficiencies, and propose recommendations for improving the alignment between ITE offerings and the needs of both the Technologies Curriculum and the rapidly changing technological landscape. By addressing these gaps, this study seeks to ensure that Australian teachers are well-prepared to inspire and equip future generations of students to succeed in a technology-driven world.

The aim of this study is to examine the gaps in technologies education within Australian ITE programs, explore the systemic factors contributing to these deficiencies, and propose recommendations for improving the alignment between ITE offerings and the needs of both the Technologies Curriculum and the rapidly changing technological landscape. By addressing these gaps, this study seeks to ensure that Australian teachers are well-prepared to inspire and equip future generations of students to succeed in a technology-driven world.

Research Questions

This study is guided by the following research questions:

1. To what extent do Australian ITE programmes prepare pre-service teachers to deliver the Australian Curriculum: Technologies, including both *Design and Technologies* and *Digital Technologies*?
2. What are the key barriers to integrating comprehensive technologies education within ITE programmes, and how do these vary across states and territories?
3. How does the five-year ITE accreditation cycle impact the responsiveness of teacher education programmes to advancements in educational technology, and what changes are needed to address this challenge?
4. What strategies can be implemented to improve the alignment of ITE programmes with technologies education in schools and the needs of Australia's future workforce in STEM-related industries?

Through a detailed analysis of ITE programme offerings across the 41 Australian universities offering ITE programmes, this study aims to provide actionable insights into how Australia's teacher preparation system can evolve to better meet the demands of 21st-century education. In doing so, it hopes to contribute to the development of a more consistent, equitable, and forward-thinking approach to technologies education in Australian schools.

Literature Review

Technologies Education in Australia

Technologies education has a long history in Australian schools, beginning with the integration of manual arts and technical studies in the mid-20th century and evolving into the current Technologies Learning Area introduced by the Australian Curriculum, Assessment and Reporting Authority (ACARA) in 2015. The curriculum aims to equip students with the knowledge and skills necessary for active participation in a technology-driven society. It is generally divided into two organisational strands: *Design and Technologies* and *Digital Technologies* (ACARA, 2015).

- The Design and Technologies strand focuses on teaching students to use design processes and systems thinking to develop sustainable solutions to real-world problems. Students engage in design thinking, project management, and the use of various materials and tools to create innovative solutions.
- The Digital Technologies strand is focused on developing students' computational thinking, programming skills, and understanding of digital systems. It prepares students for the future by fostering skills such as data analysis, algorithm design, and problem-solving using technology.

Despite the curriculum's ambitions, its successful implementation depends on how well teachers are prepared to deliver these strands, particularly in a rapidly changing technological landscape. ITE programmes, therefore, have a crucial role in ensuring that pre-service teachers are equipped with the necessary skills to teach both *Design and Technologies* and *Digital Technologies*.

While all Australian states and territories agreed to implement the Australian curriculum (Ministerial Council on Education, Employment, Training and Youth Affairs, 2008), in practice, there is significant variation, with some states, most notably NSW, developing more independent curricula. This has in turn complicated a consistent approach in ITE.

The Australian Curriculum: Technologies learning area does not extend into the senior years, unlike the English, Mathematics, Science and History learning areas. This results in inconsistency and a general lack of focus within senior Technologies education in Australia, with four broad areas of teaching areas evident in ITE programmes:

1. computing, encompassing computer science, multimedia and information technology courses;
2. industrial technologies, encompassing engineering, design and technology, and industrial arts subjects;
3. home economics, encompassing food and textile technologies subjects, and
4. agriculture subjects.

Preparation of teachers for these teaching areas in ITE varies considerably across and within states and territories, with little guidance or standards available to inform ITE programme development.

The Role of Initial Teacher Education (ITE) in Technologies Education

The responsibility for preparing teachers to teach Technologies in schools in Australia falls to ITE programmes. These programmes are guided and accredited by the Australian Institute for Teaching and School Leadership (AITSL), which provides and requires that graduates meet specific professional standards. However, while AITSL establishes the standards, individual state and territory institutions conduct the accreditation of their programmes.

Collapse of Teacher Professional Associations

ITE has traditionally utilised teacher professional networks, associations and conferences to coordinate and sustain ITE technologies education initiatives, but since the late 1990s there has been an increasing disengagement by teachers from professional associations, a trend that can be linked to several systemic factors in education. Studies have highlighted that growing administrative burdens and intensification of teacher workloads have contributed to feelings of burnout and time constraints, making it difficult for teachers to engage with external bodies such as professional associations (Ballet & Kelchtermans, 2009). Additionally, the rise of in-school professional development and compliance-driven models has shifted the focus away from broader, external professional networks (Mockler & Groundwater-Smith, 2015). Neoliberal educational reforms have also played a role, emphasising performance and accountability over traditional forms of professional collaboration, further discouraging teachers from participating in activities outside of their immediate workplace (Sachs, 2003). These trends have reduced the professional landscape of teaching and reduced teachers' engagement with professional associations.

ITE Technologies Academics Network

In 2019 the Australian Technologies Teacher Education Network (ATTEN) was established as a network of the Australian Council of Deans of Education (ACDE). The network was created to support teacher educators in remaining current in the Technologies areas, especially as a result of the demands of the implementation of the Australian Curriculum: Technologies, as well as those from industry and government to develop pre-service and in-service teacher capacity and improve the quality of technologies education received by students in Australian schools.

In such a rapidly evolving and high-stakes domain, ATTEN was established to meet the need for Technologies teacher educators from universities across Australia to work together to optimise pre-service teacher preparation in initial teacher education (ITE) programmes in the Digital Technologies and Design & Technologies areas (ACDE, 2024).

Industry Needs and the ITE Pipeline

The Australian technologies industry relies on schools to supply a pipeline of technologically literate students capable of pursuing careers in STEM fields. However, the lack of adequate technologies education in schools is a significant constraint on this pipeline (Zagami, 2022). Industry stakeholders such as the Australian Computer Society (ACS) and Engineers Australia (EA) have expressed concern that insufficient teacher preparation in technologies education not only limits the number of students entering STEM disciplines but also reduces the quality of technologies instruction in schools, leading to long-term skills shortages in key industries (Nguyen & Pudlowski, 2007).

The limited availability of pathways in ITE programmes to specialise in computer science, engineering, industrial technologies, and related fields is a significant factor contributing to this problem. While this study shows that 92% of universities offer some form of technology education, significant gaps remain, particularly in the distribution of opportunities and in states where technology education is less of a priority.

Methodology

Research Design

This study employs a qualitative document analysis methodology to examine the programme structure and course profiles of Initial Teacher Education (ITE) programmes from 41 Australian universities. The primary aim was to assess the extent to which these programmes prepare pre-service teachers to teach the Technologies learning area and technologies-related senior secondary teaching areas. In relying upon documentation detailing course offerings and learning outcomes, the study aimed to avoid the bias of self-reported survey responses.

Data Sources

The data for this study was collected from the official websites and course handbooks of 41 Australian universities. The documents reviewed include:

- Course profiles for both primary and secondary ITE programmes.
- Programme handbooks that outline the structure, content, and learning outcomes of ITE courses.
- Unit descriptions for specific technologies-related subjects.

The sample includes all Australian universities that offer ITE programmes.

Analytical Framework

The analysis was guided by an analytical framework based on the components of the Australian Curriculum: Technologies and AITSL standards. The following themes were used to code the data:

1. Coverage of Design and Technologies: The extent to which ITE programmes include units on the Design and Technologies curriculum.
2. Coverage of Digital Technologies: The extent to which ITE programmes include units on the Digital Technologies curriculum.
3. ICT and Digital Literacy: The inclusion of units specifically focused on general ICT skills, digital literacy, and technology integration into teaching practices.
4. State and Territory Variations: Differences in the content and structure of ITE programmes across Australian states and territories.
5. Specialisation Pathways: Opportunities for pre-service teachers to specialise in teaching technologies subjects at the senior secondary level.

Data Analysis Procedure

Once the data was collected, the following steps were followed:

1. Document Familiarisation: The course profiles and handbooks were thoroughly reviewed to identify relevant information on technologies education.
2. Thematic Coding: Using the analytical framework, the data was coded to categorise the coverage of *Design and Technologies*, *Digital Technologies*, ICT/DL, and other themes.
3. Comparison and Synthesis: The coded data was synthesised to identify patterns, gaps, and variations across universities and states. Special attention was given to the absence or presence of technologies education pathways in both primary and secondary programmes.

To maintain consistency in scoring, course offerings were used as the primary measure, with fractional scoring. When combined with other elements, e.g., science and technologies, a course would score 0.5 as a technology course.

Validity and Reliability

To improve validity and reliability, the study employed:

- Standardised coding frameworks for analysing ITE programme documents involving clearly defined key themes (e.g., Digital Technologies coverage, ICT/DL skills) and applying them consistently across all sources.
- Maintaining a detailed audit trail documenting all steps in the data collection, coding, and analysis process to allow other researchers to follow the methodology and verify how conclusions were reached, enhancing transparency and verifiability.
- Engaging with stakeholders involved in the ITE programmes (e.g., course coordinators and programme directors) to review and verify the accuracy of the data interpretations. This feedback loop, known as member checking, helped ensure that the findings reflected actual conditions and reduced researcher bias.

Limitations

The study's reliance on publicly available documents presented limitations, as not all course information content was accessible. This limited the depth of investigation into assessment focus and techniques, pedagogies employed, specific content taught, and the profiles of course convenors. Additionally, the analysis focuses on course profiles and could not capture informal or unlisted programme elements, such as extra-curricular opportunities. Access to accreditation documents would have provided triangulation opportunities, but these were not comprehensively available for this study.

Findings

The analysis of Australian Initial Teacher Education (ITE) programmes revealed significant inconsistencies in how technologies education is integrated into teacher preparation. While the Australian Curriculum: Technologies has been in place since 2015, some universities still do not provide adequate pathways for pre-service teachers to develop the skills necessary to teach this critical learning area. This can be demonstrated by, and attributed to three key factors:

1. **Lack of Consistent Technologies Education Across ITE Programmes (Table 1):**

- Nationally, 8% of primary ITE programmes offer no preparation for teaching any technologies education.
- Only 51% of UG (Primary), 27% of PG (Primary), 72% of UG (Secondary), and 60% of PG (Secondary) programmes explicitly teach ICT/DL skills. SA, Tasmania (TAS), and the NT have no undergraduate primary ITE programmes offering any identifiable ICT/DL education. Postgraduate primary programmes also lack ICT/DL courses, with no ICT/DL education in the ACT, NT, QLD, or Victoria (VIC).
- While 73% of secondary UG and 90% of PG ITE programmes offer a technologies teaching area, there is a much lower percentage offering specific programmes, UG studies are only available in computing teaching areas in 46.34% of programmes, industrial in 31.71%, home economics 29.27%, and agriculture in 9.76%, with similar proportions in PG programmes, with computing in 41.46%, industrial 21.95%, home economics 14.63% and agriculture in 4.88%.
- These inequalities exist in programmes nationally but are amplified when occurring in smaller states or territories where a single ITE institution provides education – ACT, NT and Tasmania. While multi-state ITE providers can assist, the access to ITE preparation for teaching technologies subjects is largely determined by geography.

Table 1:
Australian Initial Teacher Education Technology Education Courses

	UG Primary		PG Primary			UG Secondary					Teaching Areas				PG Secondary			Teaching Areas		
	ICT	DT Curric	D&T Curric	ICT	DT Curric	D&T Curric	ICT	Content	DT Curr	D&T Curr	Comp	Indust	Home Ec	Agric	ICT	Curric	Comp	Indust	Home Ec	Agric
Australian Capital Territory	1	0.5	0.5	0	0.5	0.5	1	6	2	4	2	2	1	0	1	2	0	0	0	0
University of Canberra	1	0.5	0.5	0	0.5	0.5	1	6	2	4	2	2	1	0	1	2	0	0	0	0
New South Wales (NSW)	0.58	0.46	0.38	0.42	0.29	0.29	0.67	3.04	0.96	1.17	1.71	1.08	0.58	0.58	0.67	1.25	1	0.25	0	0.42
Australian College of PE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Avondale College	1	0.25	0.25	1	0.25	0.25	1	6	1	4	1	2	2	0	1	2	1	1	0	0
Charles Sturt University	0	0.25	0.25	0	0.25	0.25	1	4.5	1.5	3	1.5	1	1	1	1	2	1	2	0	1
Macquarie University	0	0.5	0.5	0	0.75	0.75	1	0	0	0	0	0	0	0	1	2	1	0	0	0
Southern Cross University	1	1.5	0.5	1	0.5	0.5	0	10	2	2	4	4	2	2	1	2	0	0	0	0
University of New England	1	0.25	0.25	1	0.25	0.25	1	10	3	3	6	0	0	4	1	3	6	0	0	4
University of New South Wales	0	0.25	0.25	0	0.25	0.25	1	0	2	0	2	0	0	0	0	2	1	0	0	0
University of Newcastle	1	0.5	0.5	0	0.25	0.25	1	6	2	2	6	6	2	0	0	0	0	0	0	0
University of Sydney	1	0.75	0.75	0	0.25	0.25	0	0	0	0	0	0	0	0	1	0	0	0	0	0
University of Technology	1	0.25	0.25	1	0.25	0.25	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Western Sydney University	0	0.75	0.75	1	0.25	0.25	1	0	0	0	0	0	0	0	1	2	2	0	0	0

University of Wollongong	1	0.25	0.25	0	0.25	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern Territory (NT)	0	1	1	0	0.5	0.5	1	15	2	0	2	0	0	0	0	2	2	0	0	0
Charles Darwin University	0	1	1	0	0.5	0.5	1	15	2	0	2	0	0	0	0	2	2	0	0	0
Queensland (QLD)	0.69	0.69	0.63	0	0.31	0.31	0.56	3	0.63	0.75	0.63	1	0.75	0.25	0.5	1.75	1	0.75	0.5	0
Central Queensland University	0	1	1	0	0.25	0.25	1	6	0	2	0	2	2	2	1	2	0	2	2	0
Christian Heritage College	0.5	1	1	0	0.25	0.25	0.5	0	0	0	0	0	0	0	0	2	2	0	0	0
Griffith University	1	0.5	0.5	0	0.5	0.5	1	6	2	2	2	2	2	0	0	2	2	2	2	0
James Cook University	1	0.5	0.5	0	0	0	0	6	2	2	2	2	2	0	1	2	2	0	0	0
QUT	1	0.5	0.5	0	0.25	0.25	1	0	0	0	0	0	0	0	0	2	2	2	0	0
University of Queensland	0.5	0.5	0.5	0	0.5	0.5	1	0	0	0	0	0	0	0	1	0	0	0	0	0
USQ	0.5	1	0.5	0	0.25	0.25	0	6	1	0	1	2	0	0	1	2	0	0	0	0
USC	1	0.5	0.5	0	0.5	0.5	0	0	0	0	0	0	0	0	0	2	0	0	0	0
South Australia (SA)	0	0.38	0.38	0.13	0.13	0.38	0.25	5.5	0.81	0.56	3.06	0.56	0	0	0.25	0.5	0.38	0.13	0	0
Flinders University	0	0	0.5	0.5	0	0.5	0	0	0.25	0.25	0.25	0.25	0	0	0.5	0.5	0.5	0	0	0
Tabor Adelaide	0	1	0.5	0	0	0.5	1	6	0	2	0	2	0	0	0.5	0.5	0	0.5	0	0
University of Adelaide	0	0	0	0	0	0	0	10	1	0	10	0	0	0	0	1	1	0	0	0
University of South Australia	0	0.5	0.5	0	0.5	0.5	0	6	2	0	2	0	0	0	0	0	0	0	0	0
Tasmania (TAS)	0	1	1	0.5	0.5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
University of Tasmania	0	1	1	0.5	0.5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Victoria (VIC)	0.56	0.38	0.44	0	0.25	0.44	0.25	2	0.75	0.25	1	0	0.5	0	0.25	1	0.38	0.25	0.38	0

Deakin University	0	0.5	0.5	0	0.25	0.25	0	0	0	0	0	0	2	0	0	2	0	0	2	0
Federation University	1	0	0.5	0	0	0.5	0	4	2	0	2	0	0	0	0	2	2	0	0	0
La Trobe University	1	0.25	0.25	0	0.25	0.25	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Monash University	1	1	1	0	0.5	0.5	1	6	2	0	4	0	0	0	0	0	0	0	0	0
RMIT University	0	0.5	0.5	0	0.5	0.5	0	0	0	0	0	0	0	0	0	0	1	0	1	0
Swinburne University	0.5	0.5	0.5	0	0.5	0.5	0	0	0	0	0	0	0	0	1	2	0	0	0	0
University of Melbourne	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Victoria University	1	0.25	0.25	0	0	0.5	1	6	2	2	2	0	2	0	0	2	0	2	0	0
Western Australia (WA)	0.5	0.13	0.13	0.25	0.25	0.25	0.5	0	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5	0.5	0.5	0
Curtin University of Technology	1	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Edith Cowan University	0	0	0	0	0.5	0.5	1	0	2	2	2	2	2	0	0	2	2	2	2	0
Murdoch University	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
University of Western Australia	0	0.5	0.5	0	0.5	0.5	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Multi-State	1.5	0.38	0.38	0.5	0.5	0.5	1	2	1	1	1	2	2	0	1	2	3	2	3	0
Australian Catholic University	1	0.5	0.5	1	0.5	0.5	0	4	2	2	2	4	4	0	1	2	4	4	4	0
University of Notre Dame	2	0.25	0.25	0	0.5	0.5	2	0	0	0	0	0	0	0	1	2	2	0	2	0

2. State and Territory Variations:

The analysis identified considerable disparities in the inclusion of technologies education across Australian states and territories (see Tables 2, 3, 4 and 5):

- While 92% of primary ITE programmes nationwide offer some technologies education, only 75% of programmes in Western Australia (WA) and South Australia (SA) offer any identifiable technologies education preparation.
- The NSW curriculum results in a more isolated approach to technologies education that has a flow-on impact on the ITE sector. While 92% of NSW ITE programmes include technologies education, they have the lowest preparation percentage of technologies education courses in primary ITE programmes, generally half to a quarter of that provided in other states and territories, with DT and D&T combined, and combined again with science education.
- States like Queensland, the Australian Capital Territory (ACT), and the Northern Territory (NT) offer limited opportunities for specialisation in technologies education, with few elective options available to pre-service teachers in their programmes.

Table 2:
Undergraduate Primary Courses Technologies Education Inclusion

	ICT/DL	Digital	Design
ACT	100%	100%	100%
NSW	58%	92%	92%
NT	0%	100%	100%
QLD	88%	100%	100%
SA	0%	50%	75%
TAS	0%	100%	100%
VIC	63%	75%	88%
WA	50%	25%	25%
NAT	100%	100%	100%
TOTAL	51%	82%	87%

ICT/DL is absent from primary UG programmes in the NT, SA, and Tasmania, with Western Australia having significantly fewer institutions offering technology education in their primary programmes (Table 2).

Table 3:
Postgraduate Primary Courses Technologies Education Inclusion

	ICT/DL	Digital	Design
ACT	0%	100%	100%
NSW	42%	92%	92%
NT	0%	100%	100%
QLD	0%	88%	88%
SA	25%	25%	75%
TAS	100%	100%	0%
VIC	0%	63%	100%
WA	50%	50%	50%
NAT	50%	100%	100%
TOTAL	30%	80%	78%

Primary PG programmes fare worse than UG, with ACT, NT, QLD, and VIC including no ICT/DL education in any programme. Tasmania notably does not include Design and Technologies, and most SA ITEs do not include Digital Technologies (Table 3).

Table 4:
Undergraduate Secondary Courses Technologies Education Inclusion and Average Number of Teaching Area Courses

	ICT/DL	Digital	Design	Computing	Industrial	Home Ec	Agriculture
ACT	100%	100%	100%	2	2	1	0
NSW	67%	50%	42%	1.71	1.08	0.58	2.75
NT	100%	100%	0%	2	0	0	0
QLD	25%	38%	13%	0.63	1	0.75	0.25
SA	100%	75%	75%	3.06	0.56	0	0
TAS	0%	0%	0%	0	0	0	0
VIC	80%	80%	60%	1	0	0.5	0
WA	75%	75%	75%	0.5	0.5	0.5	0
NAT	100%	100%	100%	1	2	2	0
TOTAL	72%	69%	52%	24	19	14	4

In secondary UG programmes, QLD and Tasmania lack ICT/DL education, the NT has no opportunities in any non-digital teaching area, QLD focuses more on digital than other technologies, and Tasmania has not a single domestic pathway to become a secondary technologies teacher (Table 4).

Table 5:
Postgraduate Secondary Courses Technologies Education Inclusion and Average Number of Teaching Area Courses

	ICT/DL	Technologies	Computing	Industrial	Home Ec	Agriculture
ACT	100%	100%	0	0	0	0
NSW	67%	58%	1	0.25	0	0.42
NT	0%	100%	2	0	0	0
QLD	50%	50%	1	0.75	0.5	0
SA	50%	75%	0.38	0.13	0	0
TAS	100%	0%	0	0	0	0
VIC	80%	100%	0.38	0.25	0.38	0
WA	100%	75%	0.5	0.5	0.5	0
NAT	100%	100%	3	2	3	0
TOTAL	72%	69%	24	19	14	4

In secondary postgraduate, ITE programs rely on students coming with teaching area preparation from prior degrees, but the ACT, Tasmania and many programmes in NSW, QLD and SA still do not provide opportunities to become teachers of technologies subjects (Table 5).

3. Impact of the ITE Accreditation Cycle:

The reasons for this wide variation in ITE programmes vary, but ITE programme accreditation, nationally coordinated by AITSL, was intended to address these issues. Unfortunately, many technologies ITE courses include dated content, with very few mentioning computational thinking,

artificial intelligence and advanced manufacturing techniques, and no ITE programmes exploring emerging technologies such as quantum computing and additive manufacturing. The five-year ITE accreditation cycle is a barrier to adapting to rapidly advancing technological developments. Revisions to address technological changes missed during an accreditation cycle can result in a delay of at least five years in addressing ITE needs. This has impacted the incorporation of *Digital Technologies* over the last ten years and will likely hinder the integration of other advancements such as AI, additive manufacturing, and quantum computing. With the current AITSL focus on other agendas (AITSL, 2023), there is a strong likelihood that another opportunity will be missed in this accreditation cycle, resulting in an ever-increasing gap in addressing many issues, such as computational thinking and advances in manufacturing technologies.

Analysis

The study's findings highlight critical issues in the preparation of future teachers to deliver the Technologies Curriculum, both at the primary and secondary levels. These gaps are driven by several key factors:

1. Many ITE programmes have limited preparation for teaching technologies in primary schools, mainly Digital Technologies, and many programmes offer limited opportunities to be prepared to teach technologies subjects in senior secondary, particularly more traditional technologies. Most notably, Tasmania has no domestic senior secondary pathway to become a teacher of technologies subjects.
2. Accreditation Cycle and Curriculum Inflexibility:
   The five-year accreditation process hinders ITE programmes from responding promptly to technological changes. Given the rapid pace of technological innovation and its impact on technologies education, the accreditation process needs to be more adaptable to ensure that teachers are not left behind in developing essential skills like AI literacy, advances in manufacturing, and computational thinking.
3. Mismatch Between Advocacy and Practice:
   While many ITE academics champion technologies education in their research and policy development, this advocacy is not always reflected in the courses they teach or hold some responsibility for in their institutions. Constraints on curriculum design and resource allocation often prevent ITE programmes from aligning with the Technologies Learning Area of the Australian Curriculum and with changes occurring in technologies subjects offered in schools. This gap between rhetoric and practice is particularly evident in the inconsistent teaching of *Digital Technologies* across states.
4. State-Based Disparities in Teacher Preparation:
   Certain states and territories lag significantly in preparing teachers for technologies education, with limited pathways for both primary and secondary teachers. This geographical inequality exacerbates the challenges schools in these regions face when trying to implement the *Technologies Curriculum*, contributing to a national imbalance in the quality of technologies instruction.

Recommendations

Based on the findings and analysis, the following recommendations are made to address the deficiencies identified in technologies education within Australian ITE programmes:

1. Collegial Improvement Cycles:
   The Australian Technologies Teacher Education Network (ATTEN) collegially supports members in improving technologies education in their programmes, establishing national

benchmarks and highlighting best practices to support members in arguing for and fostering improvements in their ITE programmes.

2. Update the Accreditation Cycle to Allow Flexibility:
   The five-year accreditation process must support more frequent reviews and updates in response to technological advances. This flexibility would enable ITE programmes to stay current with rapidly evolving technologies and ensure teachers are adequately prepared to meet the demands of modern educational change cycles. As with the AITSL addendum (2023), this could be achieved through targeted revisions. A process of enabling external organisations such as ATTEN to suggest and support such changes should be established.
3. Ensure Minimum Curriculum Coverage for Technologies Education:
   Through accreditation, Primary ITE programmes should demonstrate their capacity to prepare graduates to teach the Australian Curriculum: Technologies learning area, including both *Design and Technologies* and *Digital Technologies*. Where states or territories choose to undertake alternatives to the Australian Curriculum, ITE programmes should demonstrate national equivalency to an accrediting body outside their state or territory.
4. Increase Specialisation Opportunities in Secondary Technologies:
   The Australian Council of Deans of Education (ACDE) should coordinate with ITE institutions to ensure that each state and territory offers sufficient pathways for pre-service teachers to specialise in key technologies teaching areas such as computer science, industrial technologies, home economics and agriculture, collegially addressing gaps in state and territory provisions.
5. Provide Career Guidance for Prospective Teachers:
   It is essential to provide better career guidance to prospective teachers, enabling them to choose ITE institutions based on their capacity to prepare them for technologies education where this is their intended teaching area, and to make informed decisions that help them avoid enrolling in programmes that do not align with their career goals. This could be achieved by the development and maintenance of a comparative guide by ATTEN with financial support from technologies industries.
6. Promote National Consistency in Technologies Education:
   Despite a nationally agreed school curriculum, ITE programmes remain unable to achieve consistency, and a national approach to technologies education in ITE programmes is needed to reduce the disparities between states and territories. This could involve national benchmarking to set standards for the content of ITE technologies education, improving consistency in the quality of teacher preparation across the country. Where AITSL cannot provide sufficient specificity, they should be encouraged to work with organisations such as ATTEN and various industry groups such as the Australian Computer Society (ACS) and Engineers Australia (EA) to develop guidance for ITE programmes to meet industry and societal needs.

By addressing these issues, Australian ITE programmes can better equip future teachers to deliver the Technologies Curriculum and contribute to developing a technologically proficient population. This, in turn, will help meet the growing demands of the technologies industry and ensure that Australia remains competitive in the global economy.

Conclusion

The findings from this study underscore significant challenges and inconsistencies in the delivery of technologies education within Australia's Initial Teacher Education (ITE) programmes. Despite the critical role technologies education plays in preparing students for a technology-driven world, many ITE programmes do not provide adequate pathways for pre-service teachers to engage with and teach the technologies learning area or subjects.

The five-year ITE accreditation cycle, while necessary for maintaining educational standards, can be a hindrance in adapting teacher preparation programmes to meet the rapidly changing demands of technological advancements. The lag between curriculum changes and their implementation in ITE programmes has resulted in gaps that affect not only teacher readiness but also the quality of technologies education students receive.

State and territory disparities further exacerbate these challenges, with some regions significantly lagging in technologies education offerings. This creates a national imbalance where schools in certain areas struggle to find qualified teachers capable of providing technologies education. As a result, students' exposure to key technological subjects largely depends on the state or institution in which they are taught, leading to inequities in educational outcomes.

It is essential that national and state education authorities, in collaboration with ITE institutions, work towards greater consistency in preparing future teachers for technologies education. Strengthening the AITSL accreditation standards, increasing flexibility in the accreditation process, and ensuring that all ITE programmes address minimum curriculum requirements for technologies education are critical steps in this direction. Additionally, providing specialisation opportunities in key technologies teaching areas and offering better career guidance for prospective teachers will help ensure that those entering the profession are well-equipped to meet the challenges of modern education.

In conclusion, addressing the gaps in technologies education within ITE programmes is crucial not only for the successful implementation of technologies education in schools but also for securing Australia's future workforce in critical STEM-related industries. Providing pre-service teachers with the necessary skills and knowledge can enable them to inspire the next generation of students to become proficient in technologies, fostering innovation, creativity, and competitiveness in the global digital economy. Without these reforms, Australia risks falling behind in developing a teaching workforce that can meet the technological demands of the 21st century.

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