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An Industry Academia Partnership Model for Mitigating the IT Skills Gap

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Skills Gap in IT

- A recent survey by NZTech has reported a grim picture of IT skills gap in NZ:
 - 4000 to 5000 skilled IT professionals immigrated to NZ every year during the last five years. However, **“covid has stopped it and its choking the pace of NZ’s recovery. We are calling on the Government to take the digital skills shortages seriously if they want to avoid an economic slowdown”**. [1]
- This scenario is true across the world
 - Study conducted in February 2021 found that more than 100,000 tech jobs have been created in UK since the beginning of pandemic. [2]
- Work Based Learning has been regarded as a possible solution to address the skill shortage
 - Educational institutions alone cannot produce that many skilled professionals

1. <https://nztech.org.nz/2021/07/05/new-zealand-facing-a-digital-skills-crisis/>

2. <https://www.zdnet.com/article/need-developers-solving-the-tech-skills-shortage-means-looking-beyond-hiring/>

NEW ZEALAND'S DIGITAL SKILLS LANDSCAPE

Demand for digital skills is still high

114,450

people employed in the tech sector in 2019.

98,583

people employed as IT professionals (across all sectors) in 2019.

\$92,250

national median salary for digital technology workers in 2019.

4,462

new IT jobs created in 2019, growing at 4.7% CAGR over five years.

4,948

new digitally skilled employees required in two years by 190 survey respondents.

3,683

visas approved for IT professionals to immigrate to New Zealand in 2019.

More focus needed on education, upskilling and reskilling

30%

of senior secondary school students took technology standards in 2019.

-2%

declining numbers of students taking technology standards over the past five years.

only 1,850

students moved into IT degree courses from secondary school in 2019.

15,325

students were enrolled across all levels of tertiary IT courses in 2019.

3,265

students graduated with computer science, IT or software engineering degrees in 2019.

only 352

students were able to get internships in 2019 after 2,699 registered for the opportunity

< 10%

of training budgets spent on digital technology upskilling.

19%

of IT professionals changed jobs in 2019 primarily for career growth not salary growth.

<200

people undertook reskilling into digital technology careers in 2019.

Lack of diversity in digital technology roles starts at education

only 27%

of the IT workforce are female, starting from only 39% taking NCEA technology at school.

only 4%

of the IT workforce are Māori, starting from only 14% taking NCEA technology at school.

only 2.8%

of the IT workforce are Pacific peoples, starting from only 9% taking NCEA technology at school.

= SKILLS MISMATCH

Source: NZTech and Digital Skills Forum, Digital Skills Aotearoa Report 2021.
https://nztech.org.nz/wp-content/uploads/sites/8/2021/01/Digital-Skills-Aotearoa-Report-2021_online.pdf

Key Takeaways

- ICT Graduate schools (Auckland, Wellington, Christchurch) resulted in 59% growth in graduates with digital skills between 2017 and 2019.
- Internships are hard to come by, but interns converts well into employees.
- Tertiary education is not only path way into tech roles
 - Online courses (Coursera, Udacity, EdX) and vendor provided (AWS, Microsoft, Google, Cisco, Fortinet etc) certifications are alternative pathways.
 - Great for upskilling, but does not provide work experince
- Unfortunately, there is very low levels of junior roles and the very limited number of internships

Addressing the Gap: Work Based Learning

- Work Based Learning has been regarded as a possible solution to address the skill shortage
 - Educational institutions alone cannot produce that many skilled professionals
 - Needs a strong partnership and alignment of outcomes between educational institutes, industry and learners.

Work Based Learning (WBL)

- WBL can be described as “a class of university programmes that bring together universities and work organizations to create new learning opportunities in workplaces.” [3].
- Three types of WBL have been identified at the tertiary level [4]:
 - Learning for Work: short term work placement
 - Learning at Work: employees gain new skills through workplace training
 - Learning through Work: employees get certification from accredited institutions

3. Boud, D., & Solomon, N. (2001). Work-Based Learning: a New Higher Education? In *ERIC*. Taylor & Francis Inc. <https://eric.ed.gov/?id=ED458409>

4. Gray, D. (2001). *A Briefing on Work-based Learning*. Learning and Teaching Support [doi=10.1.1.200.5042](https://doi.org/10.1.1.200.5042)

WBL for IT Skills

- None of the models are good fit for hardcore IT skill development:
 - IT is a very specialised discipline and requires adequate mentoring to get skilled through work placement.
 - Formal education beyond the everyday tasks, and a strong disposition to continue learning, becomes necessary for many workers to train themselves as learning workers

Our Model: Simulated WBL

- At Otago polytechnics' BIT program, we adopted a simulated WBL model:
 - Students enrol at two semester long IN700 project/studio paper at level 7.
 - Students work towards solving real world problems from community, industry and for BIT's infrastructure
 - They work with BIT's system admin, other faculty members and external members who serve as clients.
 - Students get supervision from assigned instructors who monitor students' learning and advise additional tools/learning that need to be mastered for solving the problems
 - Students work as groups where one of them works as a group leaders

Our Model: Links with Industry

- We have established Academy programs with AWS, Fortinet and Cisco
 - Students get access to latest content with hands on labs to learn about modern cloud centric application and infrastructure design.
 - Preparing for industry certification becomes an integral part of their projects
 - Students also work on implementing their own projects in addition to solving industry projects.

Example Projects

- Migrating teaching infrastructure from vSphere to Azure
 - Students working with faculty members to migrate course infrastructure for Database, Operating System Concepts and System Administration papers from vSphere to Azure.
 - These required the students to establish regular communication with faculty members teaching these courses to learn about the infrastructure requirements, learn how these can be implemented in Azure and adopt rigorous testing before delivery.
- Migrate the Gateway for “[Things Network \(LoRaWAN\)](#)” from version2 to version3.
 - This is a operational network providing low bandwidth long distance wireless connectivity.
- Establish a dynamic malware analysis framework
 - Students have setup a platform for detecting malware through dynamic analysis using the open sourced [cuckoo sandbox](#).
- Comparison of Indoor location tracking through FortiWiFi and Bluetooth Low Energy (BLE) devices.
- Developing portal for Ashburton Time Bank.

Industry Engagement

- Industry engagement is crucial for this model to work
 - Instructors actively looking to engage with industry, colleagues and local community to find suitable projects
 - Have established strong partnership with Computer Concepts Ltd who arranges a day long excursion to their state of the art data center in Christchurch. This trip is sponsored by Fortinet.
 - Partnership with a local non profit named Dunedin Timebank helps us connect with regional projects where students can help
 - BIT hosts the local IT professionals' (codecraft Dunedin) monthly meeting providing valuable networking and professional development opportunity for students and faculty.

BIT's WBL Model

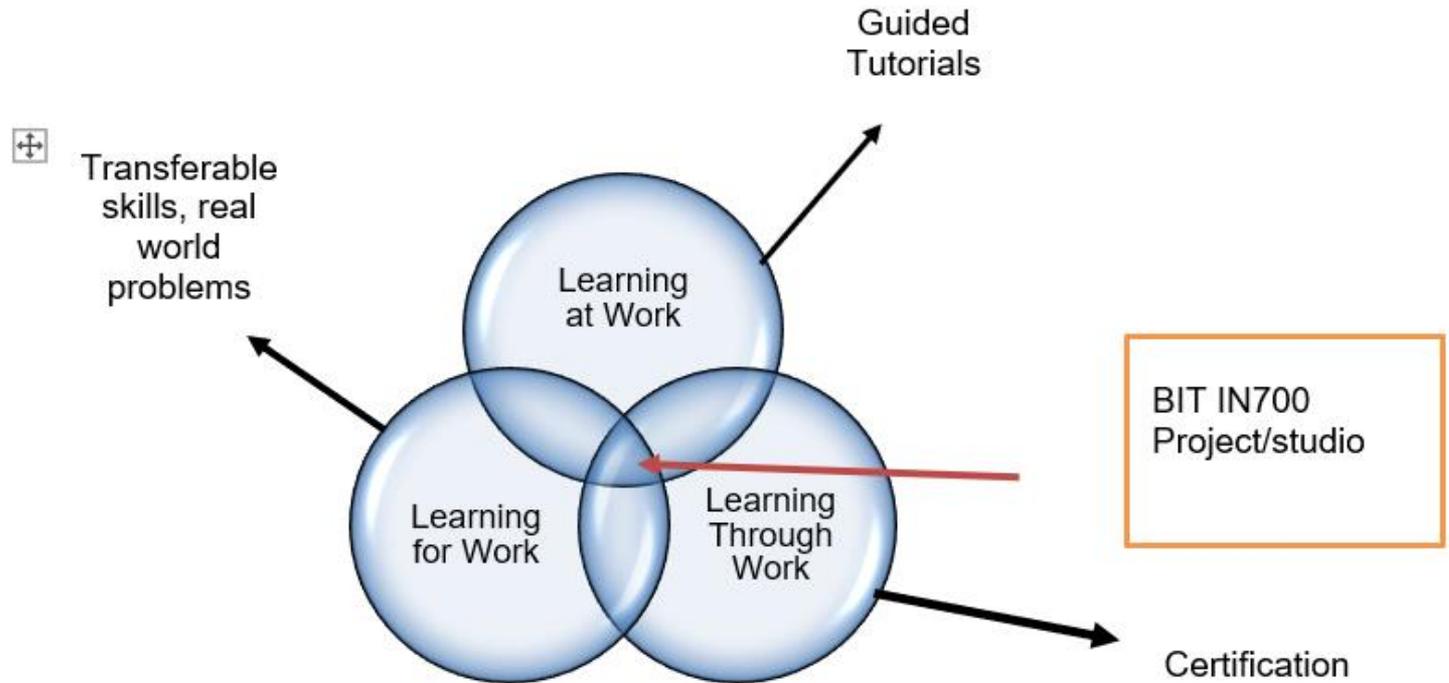


Figure 1: Different models of WBL and Relevance of BIT IN 700 Project

Curriculum: Operations and Security pathway

- The operations and security pathway has been re-designed to support the WBL model and industry trends:
 - **IN616 Operating Systems Concepts:** Focuses on basic system management, scripting and networking concepts which are essential for understanding cloud and security
 - **IN609 Operations Engineering 1:** New paper designed to introduce Azure/AWS cloud, serverless computing and containers
 - **IN700 Studio 5 and 6:** students apply the skills they have learned and pick up new skills whenever needed
 - **IN734 Operations Engineering 2:** Managing on premises Virtual machines with monitoring and config management
 - **IN720 Administrating Virtual Infrastructure:** Provides a deeper view on cloud and covers modern application deployment technics on cloud
 - **IN724 Security:** Introduces the security mindset, students learn penetration testing, secure application design and applied cryptography

Security: BIT-OP approach

- Focus on “Security mindset” with an hand-on approach
 - Teaches students how to think like an attacker. It is important to break the system in order to know how to fix it.
- Security Curriculum is spread throughout the entire degree
 - There is only one level 7 security course which focuses on hacking into target websites and server systems, involves dealing with real malware for launching network attacks and exploiting buffer overflow vulnerabilities on customized virtual machines
 - Contains 6 weeks of tailored labs with Fortinet devices on Azure. Complements the learning with a industry focus.
 - BIT courses like web/mobile applications, networking, maths, programming, database, professional practice have a security module covering relevant security implications
 - Students will be working on security awareness campaigns from next semester through a security club.
- We would like to be informed about the key skills industry needs.

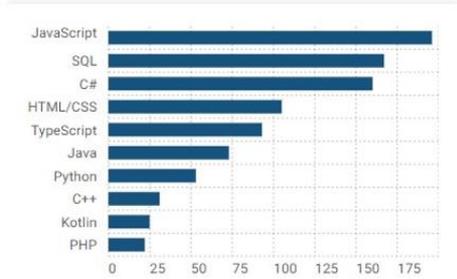
Skills Data Analysis from seek.co.nz

David Rozado, PhD
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Skills on Demand

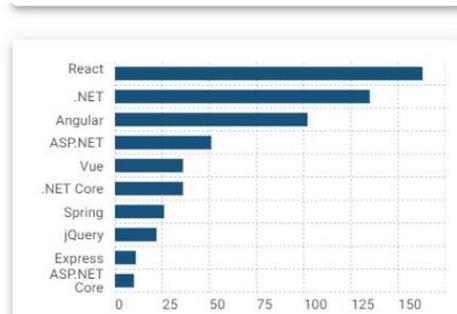
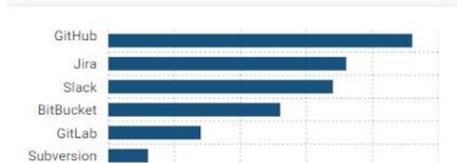


Locations



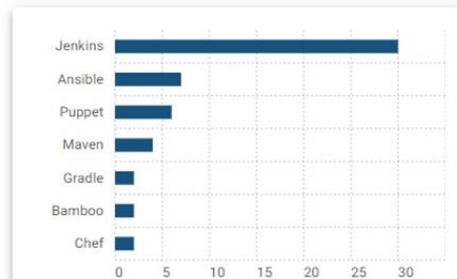
Languages

Lizards are a widespread group of squamate reptiles, with over 6,000 species, ranging across all continents except Antarctica



Frameworks

Lizards are a widespread group of squamate reptiles, with over 6,000 species, ranging across all continents except Antarctica



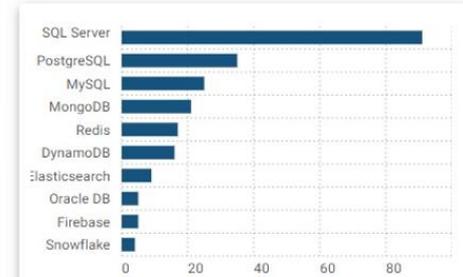
Automation

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Skills

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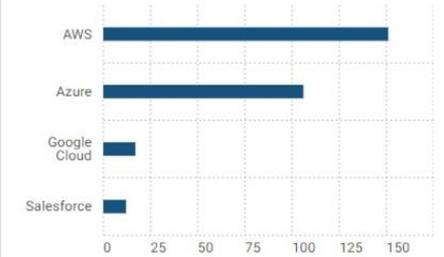
Databases

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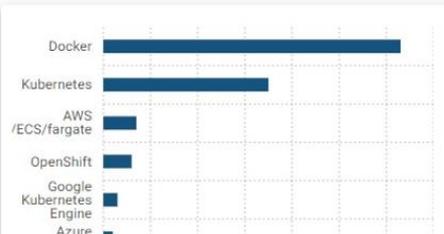
Hiring Companies

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Clouds

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Future Work

- Industry focused academy programs have opened up opportunities for new courses tailored for people working in the industry and for the ones who want to upskill their skills in IT
 - Micro credentials for upskilling
- Multi-disciplinary and hand-on focus of the vocational education space is a perfect ground for bridging the skills gap
 - Polytechnics can play a strong role in raising security awareness for the community
- Integrating cloud educational resources from major cloud vendors like AWS/Azure/gCloud/Catalyst cloud can significantly help bridging the skills gap and improve academia-industry collaboration.

Concluding Remarks

Kia whakatōmuri te haere whakamua.

I walk backwards into the future with my eyes fixed on my past.

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