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A WORLD
TOP 100
UNIVERSITY

Delivering a Work-Based Learning Degree Programme in Software Engineering

Lessons from Practice

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WORLD
CHANGING
GLASGOW

THE SUNDAY TIMES
THE SUNDAY TIMES

GOOD
UNIVERSITY
GUIDE
2024

SCOTTISH
UNIVERSITY
OF THE YEAR



The Challenge

- Employers report persistent skills gaps in new graduates
- Students struggle to apply academic knowledge in workplace
- Traditional CS education doesn't prepare students for:
 - Working with legacy codebases
 - Client interaction
 - Real-world constraints
 - Professional communication





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Work-Based Learning: A Different Model

Graduate Apprenticeships in Software Engineering

- 4-year honours degree program
- Students are both employees and students
- 80% time in workplace, 20% at university
- Launched in 2017 with Scottish Government support
- Co-designed with 26 industry partners



What Industry Told Us

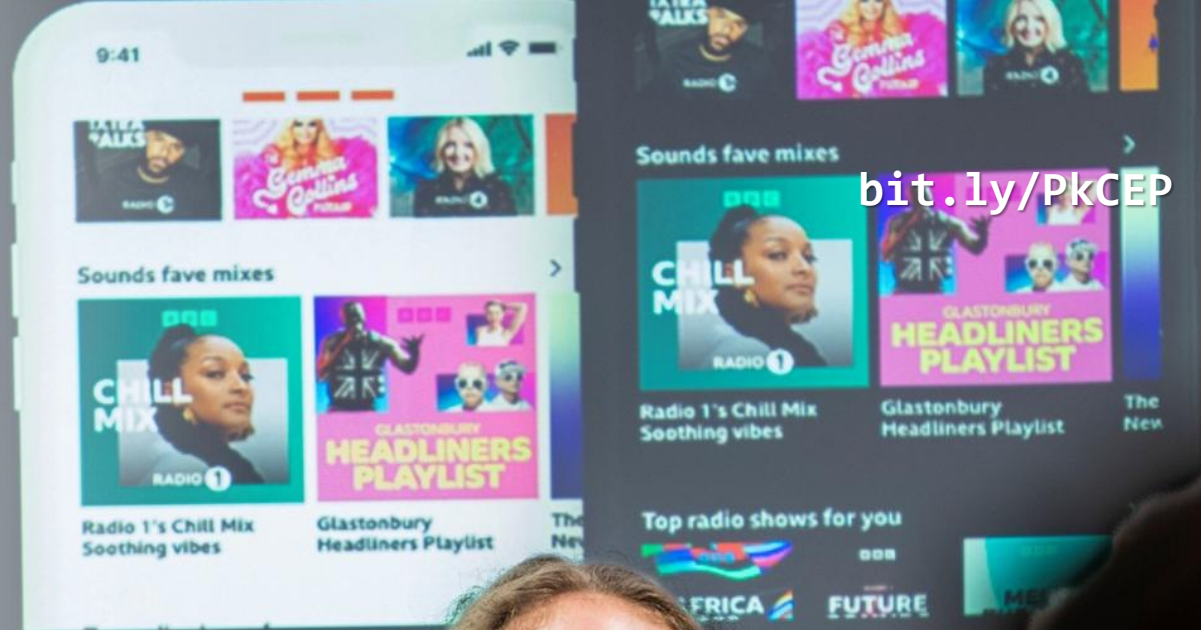
Key Findings from Industry Consultation

Technical Needs:

- Multiple programming languages
- Version control in practice
- Testing at scale
- Working with existing systems

Professional Skills:

- Written and verbal communication
- Project management
- Client interaction
- Self-directed learning



“We need developers who can join a team on day one and contribute, not start from scratch.”



Program Structure

Balancing Work and Study

- Year 1-2: Foundation building
 - Programming in multiple languages
 - Software engineering principles
 - Professional skills development
- Year 3-4: Advanced integration
 - Specialized technical modules
 - Leadership and management
 - Substantial workplace projects
- Assessment: Portfolio-based, reflective essays, workplace projects



Who Are Our Apprentices?

A Different Student Profile

- 32% from Scotland's 20% most deprived areas
- Age range: 17 to 45
- Mix of school leavers and career changers
- 37% of mature students have previous HE experience
- Different motivations, different barriers





Breaking Down Barriers

How Apprenticeships Widen Access

Financial:

- Earning while learning
- No student debt
- No need for part-time work

Educational:

- Alternative entry routes
- Recognition of prior experience
- “Second chances”

Psychological:

- “I belong in industry”
- Immediate application of learning
- Professional identity from day one





Stories of Access

“Second Chances and First Opportunities”

- **Sarah's Story:** *"I dropped out of psychology even though I was always maths focused. The apprenticeship gave me a second chance to study what matched my strengths."*
- **James's Story:** *"My school said apprenticeships were for people who couldn't handle university. They were wrong."*
- **Amira's Story:** *"As a single parent, I couldn't afford to stop working. This was my only route to a degree."*





The Role of Reflection

Making Workplace Learning Visible

- Workplace learning is often tacit and unconscious
- Reflection converts experience into explicit knowledge
- Structured reflection throughout all four years
- Based on established frameworks:
 - Boud *et al.*'s Model of Reflective Process
 - Bain *et al.*'s 5R Framework

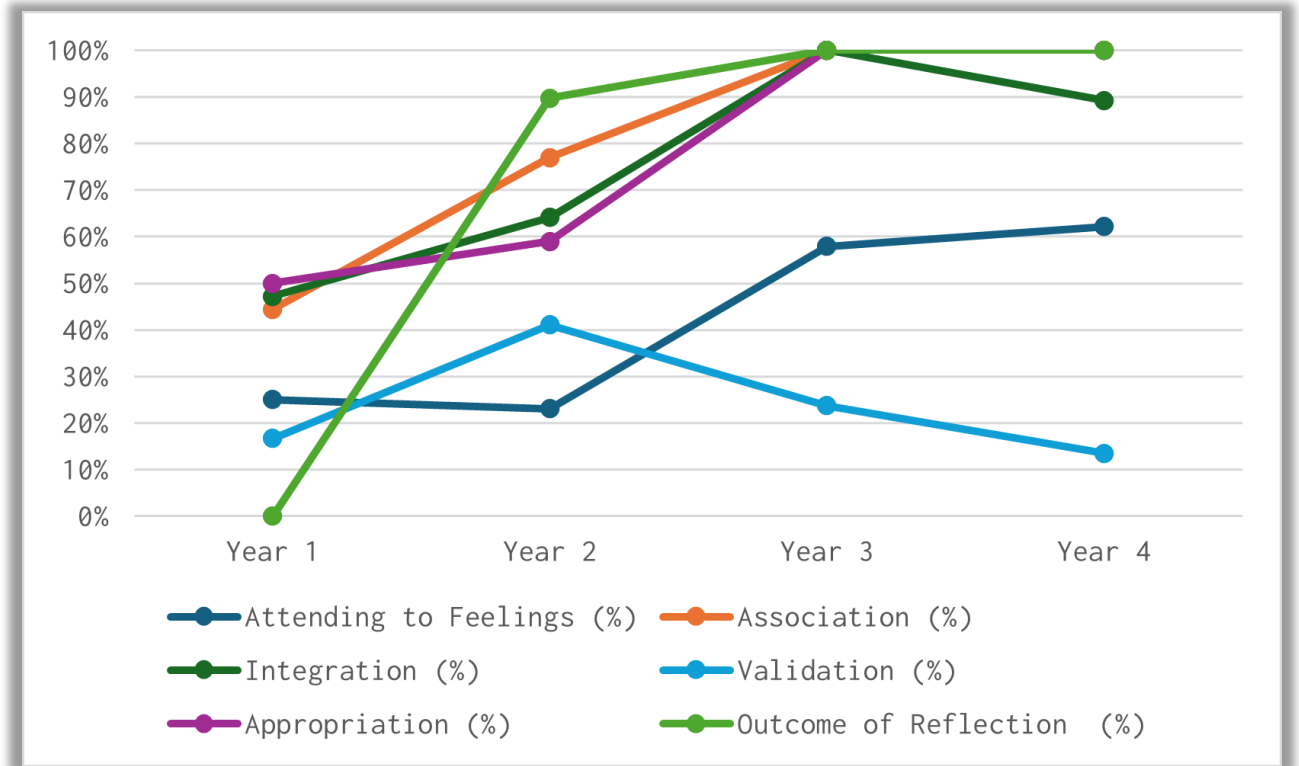




The Development of Reflective Practice

How Reflection Evolves Over Four Years

- *Year 1-2*: “Attending to Feelings” and basic “Association”
- *Year 3-4*: “Integration” (3% → 100%) and “Appropriation”
- More sophisticated reflection emerges as students mature professionally



“I’ve developed my own approach to code reviews, combining university principles with my team’s practices.”



University → Workplace Transfer

What Transfers Well

Technical Foundations:

- “Multiple programming languages gave me confidence to learn our stack”
- “Design patterns helped me understand our legacy codebase”
- “Version control theory made our Git workflow make sense”

Communication Skills:

- “University presentations prepared me to lead client demos”
- “Report writing transferred directly to documentation”

Problem-Solving Frameworks:

- “Algorithmic thinking from university helps me optimize real systems”





Workplace → University Enhancement

How Work Experience Enriches Academic Learning

Context for Theory:

- “Agile finally made sense when I lived it daily”
- “Database normalization clicked when I saw the mess without it”

Motivation for Deep Learning:

- “I studied security properly after our system was attacked”
- “Performance optimization became real when our app was slow”

Professional Perspective:

- “I approach assignments like work projects now”





Skills Best Developed in the Workplace

What Can't Be Taught in a Classroom

- *Context Switching*: Managing multiple projects simultaneously
- *Legacy Code Navigation*: Working with 10+ year-old systems
- *Stakeholder Management*: Translating between technical and business
- *Real Constraints*: Deadlines, budgets, technical debt
- *Team Dynamics*: Personality conflicts, communication styles

“University prepared me technically, but work taught me to be a professional.”



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The Confidence Factor

Building Professional Identity

- **Year 1:** *"Being thrown straight into the workplace would've been terrifying"*
- **Year 2:** *"I can contribute to team discussions now"*
- **Year 3:** *"I led my first client presentation"*
- **Year 4:** *"I'm mentoring new developers"*
- University provides psychological safety for experimentation





Challenges and Gaps

Where We Still Struggle

Academic vs. Industry Teams:

- University group work $\neq$ professional team dynamics
- Personality conflicts can't be "solved" by changing groups

Advanced Technical Transfer:

- Some students struggle to apply complex algorithms
- Gap between academic examples and industry scale

Balancing Competing Demands:

- Work deadlines vs. assignment deadlines
- Some employers better than others at supporting study





Lessons for Implementation

Evidence-Based Recommendations

- *Start with Industry, Don't Just Consult Them*
 - Deep, ongoing partnership
 - Industry mentors need training too
- *Build Reflection into Assessment*
 - Not an add-on but core to learning
 - Provide frameworks and feedback
- *Design for Different Learners*
 - Recognize diverse backgrounds
 - Multiple entry and exit points
- *Support the Whole Person*
 - Career changers need different support than school leavers
 - Address imposter syndrome explicitly





Impact and Outcomes

Evidence of Success

- *Completion Rates*: 85% (vs. 78% traditional CS)
- *Employment*: 100% employed in relevant roles
- *Salary Progression*: 40% increase over 4 years
- *Industry Feedback*: “Best prepared graduates we've hired”
- *Student Satisfaction*: 92-100% would recommend

Contributing to UN Sustainable Development Goal 4: “Ensure equal access for all to affordable and quality technical, vocational and tertiary education”





The Broader Vision

Transforming Computing Education

For Students:

- Alternative pathways to success
- Recognition of diverse talents
- Professional identity from day one

For Universities:

- Renewed industry relevance
- Authentic assessment methods
- Inclusive practices

For Industry:

- Genuinely work-ready graduates
- Diversity in tech workforce
- Sustainable talent pipeline

For Society:

- Social mobility through education
- Addressing digital skills gap
- Economic growth through inclusion



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Looking Forward

The Future of Work-Based Learning

Research Priorities:

- Long-term career trajectories
- Impact on company culture
- International comparisons

Policy Implications:

- Funding models need rethinking
- Quality assurance for distributed learning
- Recognition of work-based credentials





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Conclusion

- **Work-based learning is not “university-lite”** – it's a different, equally valid model
- **Widening access requires more than removing barriers** – it needs alternative pathways
- **Professional skills develop through practice** – but reflection makes that development visible
- **The university-workplace partnership enriches both** – bidirectional learning flow
- **This matters for social justice** – computing careers should be accessible to all



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SOFTWARE ENGINEERING GRADUATE APPRENTICESHIP

BSc (Hons)

“OUR GA EXCEEDED OUR
EXPECTATIONS AND GETS THROUGH
HIS TASKS AS QUICKLY AS WE
CAN PRODUCE THEM!”

Liam MacIsaac,
Smarter Grid Solutions



Final Thought

“I never thought university was for someone like me. My school said I wasn't academic enough. My family couldn't afford for me to stop working. But this apprenticeship changed everything. I'm not just learning to code – I'm becoming a software engineer. I belong here, in this career, in this field. And I'm good at it. That's something I never thought I'd say.”





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Thank you!

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Education
and
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References

Andrei, O., Barr, M., Nabi, S. W., & Morrison, A. (2025). Understanding Skill Transfer Between University and Workplace Through Reflective Practice: A Software Engineering Work-Based Learning Experience. *Proceedings of the 30th ACM Conference on Innovation and Technology in Computer Science Education V. 1*, 368–374. <https://doi.org/10.1145/3724363.3729119>

Barr, M., Andrei, O., & Kallia, M. (2023). Widening Access to Higher Education through Degree-level Apprenticeships in Software Engineering. *2023 IEEE Frontiers in Education Conference (FIE)*, 1–8. <https://doi.org/10.1109/FIE58773.2023.10343199>

Barr, M., Andrei, O., Morrison, A., & Nabi, S. W. (2024). The Development of Students' Professional Competencies on a Work-Based Software Engineering Program. *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1*, 81–87. <https://doi.org/10.1145/3626252.3630944>

Barr, M., & Nabi, S. W. (2022). The Development of Students' Employability Skills on a Work-Based Software Engineering Degree Programme. *2022 IEEE Frontiers in Education Conference (FIE)*, 1–9. <https://doi.org/10.1109/FIE56618.2022.9962611>

Barr, M., Nabi, S. W., & Andrei, O. (2025). *The Development of Reflective Practice on a Work-Based Software Engineering Program: A Longitudinal Study*. 53–61. <https://doi.org/10.1109/CSEET66350.2025.00012>

Barr, M., & Parkinson, J. (2019). Developing a Work-based Software Engineering Degree in Collaboration with Industry. *Proceedings of the 1st UK & Ireland Computing Education Research Conference*, 1–7. <https://doi.org/10.1145/3351287.3351292>

Smith, S., Fabian, K., Taylor-Smith, E., Barr, M., Berg, T., Bratton, A., Kolberg, M., Paterson, J., & Zarb, M. (2023). 'They gave me an opportunity, and I took it': Motivations and concerns of adult apprentices. *Journal of Vocational Education & Training*. <https://doi.org/10.1080/13636820.2023.2255576>

