Journal of Information Technology Education: Research

An Official Publication of the Informing Science Institute
InformingScience.org

JITEResearch.org

Volume 24, 2025

BETWEEN AMBITION AND IMPLEMENTATION: A COMPARATIVE STUDY OF MALTA'S ICT C3 CURRICULUM IN THE CONTEXT OF SMALL-STATE DIGITAL EDUCATION

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ABSTRACT

Aim/Purpose	To identify where Malta's ICT C3 curriculum aligns with and diverges from leading international ICT education models, and what this reveals about how small states can balance curricular innovation with structural coherence and international recognition.
Background	As digital competence becomes central to 21st-century education, small states face particular challenges in developing ICT education curricula that balance local innovation with international portability. Malta's transition from the European Computer Driving License (ECDL) to the ICT C3 curriculum represents an ambitious policy reform; however, recent empirical research has identified tensions between the progressive curriculum content and the structural implementation capacity.
Methodology	Using Goodlad's curriculum theory and Phillips and Ochs' policy borrowing framework, this study conducts a systematic document analysis of eight national ICT curricula. Thematic coding across seven digital competence domains enables cross-policy comparison, with findings contextualised against empirical evidence from Malta's implementation experience.
Contribution	This paper contributes to comparative curriculum literature by developing an analytical framework for evaluating digital education policies across contexts and identifying the specific structural challenges small states face when adapting global ICT education trends while maintaining local relevance. Overall, the

Accepting Editor Kathryn MacCallum | Received: September 28, 2025 | Revised: November 13, 2025 | Accepted: December 2, 2025.
Cite as: Vassallo, D., Govus, G., & Busuttil, L. (2025). Between ambition and implementation: A comparative study of Malta's ICT C3 curriculum in the context of small-state digital education. *Journal of Information Technology Education: Research, 24,* Article 43. https://doi.org/10.28945/5674

	study reveals that while Malta's ICT C3 curriculum is content-innovative, sustained structural alignment and implementation capacity remain critical for small states seeking to translate policy ambition into educational impact.
Findings	While Malta's curriculum aligns well with international trends in content innovation, particularly in emerging technologies such as AI and blockchain, a comparative analysis reveals weaknesses in progression tracking, credentialing pathways, and international qualification alignment that distinguish it from more established systems. These policy-level gaps correlate with implementation challenges identified in recent empirical research.
Recommendations for Practitioners	Small states should prioritise strengthening structural supports, including evolving moderation systems, clearer progression frameworks, and international alignment mechanisms, alongside innovative content. A dual-pathway approach is recommended, retaining curricular breadth in lower years while strengthening nationally certified pathways in the upper secondary years through more consistent external moderation and clearer alignment with international benchmarks.
Recommendations for Researchers	The analytical framework developed here should be tested across additional small-state contexts and extended to include systematic implementation and outcome studies. Future research should examine the relationship between policy design features and actual learning outcomes.
Impact on Society	Understanding how small states can effectively adapt global educational trends while maintaining structural coherence is crucial for educational equity and national development in an increasingly connected world. This study identifies policy-level factors that may determine whether ambitious curriculum reforms translate into meaningful student outcomes.
Future Research	Applying this comparative framework to implementation studies, investigating student progression trajectories under different policy models, and exploring hybrid certification approaches that balance national innovation with international portability.
Keywords	ICT curriculum, digital competence, comparative education, policy analysis, Malta, curriculum design, small states, policy borrowing

INTRODUCTION

In an era increasingly shaped by artificial intelligence, datafication, and global digital economies, the ability to develop robust ICT competencies has become central to educational reform worldwide. From coding and cybersecurity to digital citizenship and content creation, digital competence now encompasses a broad range of skills essential for student success in both academic and professional domains. In response, many countries have introduced or revised national ICT curricula to better reflect the demands of 21st-century learning.

Malta's ICT C3 curriculum, introduced in 2018 as a replacement for the European Computer Driving Licence (ECDL), represents one such national effort. Spanning five years of compulsory education, the curriculum aims to embed digital literacy, computational thinking, and ethical use of ICT across middle and senior secondary schooling. However, despite its innovative scope and emphasis on emerging technologies, recent empirical research has revealed tensions between the curriculum's ambitious policy vision and its practical implementation capacity (Busuttil & Vassallo, 2025). These findings raise critical questions about coherence, progression, and long-term impact in small-state curric-

ulum reform. In this study, the term small state refers to education systems characterised by structural features that shape policy-making and implementation, rather than population size alone. These defining characteristics include compact administrative structures that enable rapid policy cycles, dense policy networks that facilitate direct stakeholder communication, and implementation scale constraints that require strategic resource allocation.

The ICT C3 curriculum was developed by the Malta Ministry for Education as part of a national strategy to modernise ICT education following the phase-out of ECDL certification. Rooted in the National Curriculum Framework (Ministry for Education and Employment, 2012), it is organised across three attainment levels, each defined by distinct learning outcomes that progressively develop students' digital literacy, computational thinking, and ethical technology use. Implemented during Years 7–11, the C3 syllabus introduces applied computing concepts, including coding, web development, data handling, and emerging technologies such as artificial intelligence and blockchain. The syllabus emphasises project-based learning and continuous assessment to foster creativity, critical thinking, and responsible digital citizenship among learners.

This study employs a comparative policy lens to examine Malta's ICT C3 curriculum design, using Goodlad's (1979) multi-layered curriculum theory and Phillips and Ochs' (2004) framework for policy borrowing and transfer. The analysis compares Malta's curriculum with those of global models from Europe (UK, Estonia, Finland, Germany), the Asia-Pacific (Singapore, Australia), and North America (USA) to determine whether international frameworks can inform sustainable education pathways for small states. Specifically, the study investigates how Malta balances innovation in project-based and applied learning with structural sustainability and international recognition. Most comparative studies focus on large education systems or examine implementation within single national contexts, leaving the dynamics of small states underexplored. Given the rapidly shifting landscape of digital education, the tension between international frameworks and local contextual needs, and the specific constraints and opportunities facing small-state education systems, this study investigates three core research questions:

1. How does Malta's ICT C3 curriculum compare structurally with international ICT education policies in terms of content innovation, progression frameworks, and assessment approaches?
2. How do international ICT education models inform or contrast with Malta's current policy approach?
3. What curriculum policy reforms could help small states achieve both local relevance and global recognition in digital education?

These questions are explored through a comparative curriculum analysis using document analysis, thematic coding, and theoretical frameworks drawn from Goodlad (1979) and Phillips and Ochs (2004).

LITERATURE REVIEW

ICT ENTITLEMENT AND 21ST CENTURY DIGITAL COMPETENCE

As digital tools increasingly shape how students learn and participate in society, ICT education has evolved from a peripheral skillset to a core educational entitlement. International organisations spanning education (Law et al., 2018), economics (Lobato, 2015), technology (International Telecommunications Union, 2017), and regional policy (European Commission, 2020) have consistently emphasised the importance of digital literacy for economic participation, democratic engagement, and social inclusion. These frameworks define ICT entitlement as a student's right to access structured opportunities to develop skills in information literacy, computational thinking, ethical digital citizenship, and problem-solving.

The International Society for Technology in Education (ISTE) (2016) expands this conceptualisation by framing ICT as a foundation for creativity, collaboration, and innovation. Similarly, Voogt and Roblin (2012) call for a reconceptualisation of curriculum design to embed 21st-century skills, including digital fluency and computational reasoning, as central rather than peripheral objectives. This shift reframes digital competence from a functional skillset to a transformative dimension of literacy that underpins interdisciplinary learning and civic participation, aligning with Redecker and Punie's (2017) emphasis on digital competence as a driver of pedagogical innovation and professional change.

Recent research continues to expand digital-competence models in response to AI, sustainability, and emerging pedagogical challenges. Ng et al. (2023) highlight the growing need for educators to develop AI-related digital competencies, integrating the DigCompEdu and P21 frameworks to prepare learners for intelligent and data-driven environments. Rahimi and Mosalli (2025) provide empirical validation of the DIGIGLO framework, showing how twenty-first-century digital competence predicts teachers' creative, problem-solving, and critical-thinking skills. Complementing these teacher-focused studies, Mannila (2023) emphasises the developmental progression of computational thinking and digital literacy, advocating for an early, cross-disciplinary introduction of these skills within the curriculum. Similarly, Vuorikari et al. (2022) expand the DigComp 2.2 framework to include data ethics, sustainability awareness, and responsible use of AI technologies. Collectively, these contributions illustrate a global shift from instrumental ICT instruction toward a holistic vision of digital education that integrates ethical, cognitive, and developmental dimensions of evolution that underpins the analytical perspective adopted in this study.

However, significant variation exists in how national curricula interpret and operationalise this entitlement. Some countries embed ICT across all subjects as a transversal competence (e.g., Finland, Australia), while others retain ICT as a standalone subject (e.g., Malta, UK). These structural differences reflect not only policy choices but also what Steiner-Khamsi (2012) identifies as historical, cultural, and resource-based constraints that affect curriculum reform trajectories and implementation capacity.

Recent empirical evidence from Malta illustrates these tensions. Busuttil and Vassallo (2025) found that while 87.5% of ICT teachers demonstrated a clear understanding of computational thinking concepts, significant gaps remained in their confidence in implementing advanced topics, such as artificial intelligence and blockchain. This disconnect between policy ambition and classroom readiness echoes Livingstone's (2012) concern that curriculum reform can outpace the systemic capacity required for meaningful digital learning.

Curriculum Reform and International Influences

Comparative studies in curriculum reform highlight how countries engage in what Phillips and Ochs (2004) term policy borrowing, or the selective adoption of foreign educational models based on their perceived success. In ICT education, global exemplars such as Estonia, Singapore, and the UK have influenced curriculum reforms in smaller systems, including Malta, by promoting learning structures that blend computational thinking with ethical, creative, and applied learning outcomes.

Yet, borrowing is not replication. As Goodlad (1979) argues in his multi-level model of curriculum, there is often a disconnect between the intended curriculum (policy and design), the implemented curriculum (teacher practice), and the attained curriculum (student learning outcomes). Voogt and Roblin (2012) caution that reform efforts frequently fall short when systemic capacity, such as infrastructure, assessment mechanisms, or teacher training, is inadequate to support deep implementation.

The literature on small-state education systems provides additional insight into these challenges. Bray et al. (2003) argue that small states face particular vulnerabilities in curriculum reform due to limited economies of scale, reduced institutional redundancy, and heightened exposure to external policy

pressures. However, Bray and Packer (1993) suggest that small states also possess advantages in educational reform, including greater policy agility, stronger social cohesion, and more direct communication channels between policymakers and practitioners.

Malta's experience with ICT curriculum reform appears to exemplify both these advantages and constraints. The rapid transition from ECDL to the C3 curriculum demonstrates policy agility. Yet, implementation challenges identified by Busuttil and Vassallo (2025), including resource disparities between school sectors and uneven teacher preparation, reflect the capacity limitations that Bray et al. (2003) associate with small-state education systems.

These theoretical models provide the conceptual grounding for this study's dual focus: understanding Malta's ICT C3 curriculum both as a national policy innovation and as a product of global curricular flows. They also frame the comparative analysis by offering tools to assess whether adequate structural frameworks support intended digital competencies and whether policy design features can predict implementation success across different national contexts.

Small States and Curriculum Reform

Education systems in small states face a distinct set of opportunities and constraints in curriculum development. As Bray and Packer (1993) and Bray et al. (2003) note, small states often operate within compact administrative structures that allow for greater agility in policy reform and closer communication between policymakers and practitioners. However, these advantages are balanced by limitations in institutional capacity, specialist expertise, and resource availability, which can constrain implementation and long-term sustainability.

Comparative education literature has long recognised the tension between policy ambition and structural capacity in small-state contexts. Jules (2010) and Crossley (2019) highlight that while small states can rapidly adopt global innovations, they are also more vulnerable to external policy pressures and donor influence. Consequently, curriculum borrowing and adaptation in small states often involve a delicate balance between local priorities and international expectations.

In the context of digital education, these dynamics are particularly salient. Small systems, such as those in Malta, Estonia, and Singapore, demonstrate how targeted investment and strategic alignment can produce strong curriculum innovation despite scale constraints. However, as Bray and Packer (1993) argue, sustainable digital reform in small states depends on building long-term implementation infrastructure, including teacher professional development, moderation systems, and continuous feedback loops. This study positions Malta's ICT C3 curriculum within this broader discourse, examining how small-state dynamics shape the balance between innovation, capacity, and coherence in digital education reform.

Digital Competence Frameworks and Comparative Analysis

Across national systems, ICT education frameworks reveal both convergence and divergence in how digital competence is defined and operationalised. Drawing on curriculum documents from eight countries, this study identifies recurring thematic priorities that reflect an international consensus on what constitutes effective digital education, while acknowledging contextual variations in structure and implementation.

Based on this cross-national review, seven key competencies were identified as recurrent priorities in contemporary ICT curricula. These are aligned with established frameworks such as the ISTE Standards for Students (ISTE, 2016), UNESCO's ICT Competency Framework for Teachers (Law et al, 2018), the European Digital Competence Framework for Citizens (DigComp 2.2) (Vuorikari et al., 2022), and OECD's digital literacy goals (Lobato, 2015). To ensure conceptual consistency, these frameworks were comparatively reviewed to extract overlapping constructs that address knowledge, skills, and attitudes within digital education. Through thematic mapping, seven broad domains of competence were derived, encompassing digital literacy, problem-solving, collaboration, creativity,

ethical use, and societal awareness. These domains, detailed below, provided a coherent analytical basis for comparing curricula across countries, aligning with internationally recognised standards while allowing flexibility for national interpretation:

1. **Digital Literacy –** foundational skills for navigating digital environments
2. **Problem Solving and Computational Thinking –** algorithmic reasoning and systematic problem decomposition
3. **Information Management –** data handling, privacy awareness, and information evaluation
4. **Communication and Collaboration –** digital teamwork and online interaction skills
5. **Cybersecurity and Responsible Use –** digital citizenship and ethical technology use
6. **Creativity and Content Creation –** multimedia production and innovative technology application
7. **Understanding the Societal Impact of ICT –** critical awareness of technology's social, economic, and ethical implications

Research by van Laar et al. (2017) validates this framework through a systematic literature review, identifying these competencies as crucial for 21st-century workforce readiness. Furthermore, several scholars (e.g., Binkley et al., 2011; Chen & Hui, 2024) argue that these skills are best developed through authentic, contextual learning experiences rather than isolated technical instruction. Significant variation exists in how these competencies are structured within national curricula. Countries like Singapore and Estonia integrate computational thinking from early years through applied learning programs that combine coding with real-world problem-solving (Republic of Estonia, Ministry of Education and Research, 2021). Finland adopts a transversal approach, embedding digital competencies across all subjects while maintaining strong teacher autonomy in implementation (Finnish National Agency for Education, 2014). Malta's approach represents a hybrid model with a standalone curriculum that incorporates emerging technologies, such as artificial intelligence and blockchain, while emphasising project-based assessment and ethical reflection (Ministry for Education, Malta, 2023). However, as Busuttil and Vassallo (2025) demonstrate, this ambitious content scope creates implementation challenges, particularly where teacher preparation and infrastructure support lag behind curriculum expectations.

Assessment and Credentialing in ICT in Education

A critical dimension of ICT curriculum design involves assessment and credentialing mechanisms that validate student learning and provide pathways for further education or employment. An international comparison reveals significant variation in assessment approaches, ranging from formal examination systems to competency-based frameworks and hybrid models that combine multiple assessment types.

Research by Black and Wiliam (2010) emphasises that assessment systems significantly influence both teaching practices and student learning outcomes. In ICT education, this relationship is particularly complex because digital competencies often require authentic, performance-based demonstration rather than traditional knowledge recall (Lobato, 2015).

Malta's hybrid assessment model, which combines practical coursework (60%) with written examinations (40%), aligns with constructivist learning principles. This approach emphasizes student-centered learning, where learners actively build knowledge through experience, and allows for creative, applied assessment of digital skills while providing structured evaluation of theoretical knowledge. While the ICT C3 curriculum is nationally accredited in Malta, questions remain about its recognition by post-secondary institutions, many of which do not accept it as a valid qualification for general entry across all subject areas, including ICT-related courses. As Schleicher (2018) notes, assessment systems benefit from clear validation mechanisms, such as national moderation, transparent benchmarking, or recognised certification, that help build trust in the qualifications they produce. Very recently, the moderation of the coursework component has been introduced within the ICT C3 curriculum,

and while this marks a positive step toward greater quality assurance, further strengthening and systematisation of moderation practices could enhance the credibility, comparability, and wider recognition of the qualification, both locally and internationally. These concerns are further reinforced by local teacher perspectives. Busuttil and Vassallo's (2025) finding that 75.9% of teachers believe essential practical skills from the ECDL framework were not adequately carried forward into the ICT C3 curriculum suggests potential gaps in workplace and further education readiness.

Conversely, countries like the UK provide formal qualifications through established examination boards, offering clear progression pathways and international recognition, but potentially constraining pedagogical innovation (e.g., Pearson Edexcel). Singapore's model appears to balance these approaches through applied learning programs, though more detailed documentation is needed to assess how assessment is integrated with industry standards.

The Maltese ICT C3 Curriculum in Context

Malta's transition from the ECDL to the ICT C3 curriculum represents a significant shift from software proficiency training to comprehensive digital competency development. This change reflects broader international trends identified by Wing (2006) and Redecker and Punie (2017) toward curricula that emphasise computational thinking, creativity, and ethical technology use alongside technical skills.

The ICT C3 curriculum's reference to emerging technologies, such as artificial intelligence, blockchain, and robotics, positions Malta among the more innovative national approaches to digital education. However, recent empirical research reveals significant implementation challenges that illustrate broader theoretical concerns about curriculum reform in small-state contexts.
Busuttil and Vassallo's (2025) study of 112 ICT teachers across Malta's educational sectors provides crucial insights into the gap between curriculum intentions and classroom realities. Their findings reveal that while teachers generally support the curriculum's vision, confidence in delivering advanced content varies significantly, with less than half feeling prepared to teach artificial intelligence and cybersecurity effectively. While the study does not disaggregate teacher confidence by sector, it does highlight that non-state schools face greater resource constraints, which may exacerbate challenges in delivering advanced content. This highlights equity concerns that Bray et al. (2003) identify as endemic to small-state education systems.

As discussed earlier, moderation within the ICT C3 curriculum remains in development and poses important implications for implementation and quality assurance. Greater clarity around progression tracking and assessment structures may also support the curriculum's long-term sustainability and strengthen its international comparability. As Livingstone (2012) highlights, the development of digital competency benefits from longitudinal monitoring and systematic feedback to ensure the effective transfer of skills into real-world contexts.

These challenges reflect what Hopmann (2003) terms the implementation problem in curriculum reform, or the tendency for policy innovations to falter when supporting infrastructure, teacher preparation, and assessment systems lag behind curricular ambitions. For small states like Malta, addressing these implementation gaps requires strategic attention to both local capacity building and international alignment, a tension that this comparative study seeks to illuminate through cross-national policy analysis.

Implementation Challenges and Pedagogical Shifts

Despite its conceptual strengths, the ICT C3 curriculum faces several challenges in implementation. Busuttil and Vassallo (2025) report that Maltese educators frequently struggle to deliver advanced topics such as blockchain and artificial intelligence, particularly when teaching younger students who require substantial scaffolding to grasp abstract digital concepts. Similar concerns have been observed in other European contexts, such as Portugal, where Costa et al. (2012) also found that emerging ICT

topics can overwhelm younger learners. Busuttil and Vassallo (2025) further highlight that some Maltese schools face resource limitations that hinder effective implementation, including unequal access to hardware, software, and professional development. Finally, the curriculum's shift from traditional examinations to coursework and project-based assessment introduces pedagogical demands that some teachers find challenging, particularly in terms of preparation, classroom management, and student engagement.

Research Gaps and Study Justification

While extensive literature exists on digital competency frameworks and ICT curriculum design, significant gaps remain in understanding how small states can effectively balance policy innovation with implementation coherence. Existing comparative research tends to focus on large education systems, such as the UK, Australia, or the United States, where institutional capacity, funding structures, and policy diffusion mechanisms differ substantially from those in small-state contexts. As a result, the unique structural, administrative, and capacity-related challenges that shape curriculum reform in small states are often overlooked or treated only tangentially in global education policy studies.

This study addresses that gap by situating Malta's ICT C3 curriculum within the wider international policy landscape and examining how small-state systems translate global policy trends into locally implementable curricula. It contributes conceptually by extending Goodlad's (1979) curriculum theory and Phillips and Ochs' (2004) policy borrowing framework to the underexplored domain of small-state digital education. Empirically, it integrates Malta's implementation evidence (Busuttil & Vassallo, 2025) with cross-national curriculum analysis across eight countries, providing a rare comparative perspective that connects policy design with the practical realities of implementation.

This dual focus fills a gap between high-level policy discourse and classroom-level practice, demonstrating how curriculum coherence depends on alignment between innovation, teacher capacity, and assessment infrastructure. By analysing Malta's C3 curriculum through an international lens, the study not only clarifies the mechanisms through which small states engage with global reforms but also highlights the policy levers required to sustain long-term digital education reform in resource-constrained contexts.

The study thus contributes to the literature by: (1) developing and applying a systematic framework to compare ICT curriculum policies across eight diverse national contexts; (2) analysing Malta's ICT C3 curriculum design and implementation within this international framework; and (3) proposing potential policy pathways for small states seeking to balance curricular innovation with structural coherence and international recognition.

METHODOLOGY

Research Design

This study adopts a qualitative comparative policy analysis to evaluate how Malta's ICT C3 curriculum aligns with international trends in digital education reform. The research is grounded in two complementary theoretical frameworks: Goodlad's (1979) multi-layered curriculum theory, which distinguishes between intended, implemented, and attained curricula; and Phillips and Ochs' (2004) four-stage model of policy borrowing (attraction, decision, implementation, and internalisation).

The theoretical models were applied as complementary analytical lenses. Goodlad's (1979) curriculum theory provided a structural framework to distinguish between intended, implemented, and attained curriculum layers, while Phillips and Ochs' (2004) policy-borrowing model guided the interpretation of how international frameworks were adapted within the Maltese context. Together, they enabled systematic comparison between policy intentions and curricular structures across small and large states.

The integration of these two frameworks was particularly valuable for connecting the structural and policy dimensions of curriculum reform. Goodlad's (1979) model informed the internal analysis of curricular design and progression within each system, whereas Phillips and Ochs' (2004) stages of borrowing illuminated the external policy dynamics that shape how international models are adopted or adapted in small-state contexts. This dual-lens approach ensured both horizontal (cross-country) and vertical (policy-to-practice) coherence throughout the analysis.

The study employs an interpretivist approach, focusing on document-based analysis to understand how curriculum policies are structured, positioned, and justified across different national contexts. This approach is particularly suited to comparative curriculum research as it enables systematic analysis of policy intentions, structural features, and assessment frameworks without requiring primary data collection across multiple countries (Steiner-Khamsi, 2012).

Malta's ICT C3 curriculum serves as the primary case study, informed by recent research (Busuttil & Vassallo, 2025) that highlights implementation challenges and reveals gaps between policy ambition and classroom reality. This case study anchors a broader analysis of how curriculum design features may shape implementation outcomes and influence system-level coherence.

The comparative dimension incorporates seven additional national ICT curricula, selected to represent diverse approaches to digital education policy. This selection enables examination of how different structural choices, standalone versus integrated models, formal versus portfolio-based assessment, centralised versus decentralised implementation, influence curriculum coherence and sustainability.

Analytical procedure

The comparative analysis followed a qualitative content-analysis approach. Each national curriculum document was examined against the seven digital-competence domains outlined in the literature review. A coding matrix was developed to identify explicit and implicit references to these domains, as well as to curricular features such as aims, pedagogy, and assessment. Codes were grouped thematically and aligned with Goodlad's (1979) three curriculum layers to assess the coherence between stated policy goals and practical implementation. This process allowed for within-case analysis of each national curriculum, followed by cross-case comparison to identify recurring patterns, divergences, and implications for small-state policy adaptation.

The units of comparison were the lower-secondary and upper-secondary ICT or digital-education programmes for learners aged 11 to 16, ensuring alignment across national systems in scope and target level.

Theoretical Framework

Goodlad's curriculum theory

Goodlad's (1979) multi-level curriculum model provides the analytical lens for examining curriculum coherence across national systems. The framework distinguishes between three levels:

- **Intended curriculum**: The official policy documents, syllabi, and learning outcomes as articulated by education authorities
- **Implemented curriculum**: How policies are interpreted and enacted by teachers and schools
- **Attained curriculum**: What students actually learn and are able to demonstrate

This study applies Goodlad's (1979) framework primarily to analyse the intended curriculum across eight countries and to examine Malta as a detailed case study across all three levels. While implementation and attainment data are limited for most countries, Malta's recent empirical research (Busuttil & Vassallo, 2025) enables deeper insight into how policy design features may influence implementation success.

Goodlad's model is particularly useful for comparative analysis as it helps identify alignment or misalignment between curriculum policy intentions and practical outcomes. In this study, primary emphasis is placed on the intended curriculum through document analysis, while the implemented and attained levels are explored through secondary sources and existing empirical studies where available.

Phillips and Ochs' policy borrowing framework

Phillips and Ochs' (2004) four-stage model of policy borrowing provides the theoretical foundation for understanding how international influences shape national curriculum development. The model comprises:

1. **Cross-national attraction**: How countries become aware of and interested in foreign educational practices
2. **Decision**: The process of selecting and adapting foreign models to suit local needs
3. **Implementation**: How borrowed policies are enacted within national systems
4. **Internalisation**: The extent to which borrowed elements become embedded in local educational culture

This framework helps analyse Malta's ICT C3 curriculum as both a national innovation and a product of global policy flows. It enables critical examination of how international trends are selectively adopted and reshaped within small-state contexts.

Data Collection

Document selection

Primary sources were systematically collected from official education ministries, national curriculum authorities, and recognised educational agencies. Rather than focusing on single documents, the selection prioritised comprehensive curriculum frameworks that reflect varied structural approaches to ICT education across diverse national contexts. Supporting documentation, such as curriculum guides, assessment frameworks, and implementation resources, was accessed through official portals and ministry websites. Where full documents were unavailable, analysis drew on publicly available policy summaries, learning outcome frameworks, and officially endorsed descriptions. Table 1 presents the eight curriculum frameworks analysed, selected to enable comparative analysis of organisational choices and their implications for curriculum coherence and sustainability. This approach acknowledges the practical challenges of comparative curriculum research while ensuring a consistent focus on substantive policy structures over document-specific formats.

Selection criteria

Countries were selected using purposive sampling based on five key criteria:

1. **Curriculum model diversity**: Ensuring representation of different structural approaches, including standalone ICT subjects, cross-curricular integration, and mixed implementation models across diverse educational systems
2. **Geographic and policy diversity**: Including examples from Europe, Asia-Pacific, and North America to capture different educational traditions and policy contexts
3. **Innovation recognition**: Countries acknowledged for leadership in digital education reform or computational thinking integration
4. **Document accessibility**: Availability of comprehensive, recent curriculum documentation in English or with reliable official translations
5. **Relevance to small-state contexts**: Inclusion of both larger systems for a comparative perspective and smaller systems (Estonia, Singapore) that may offer more directly applicable insights for Malta

Supplementary sources

Document analysis was supplemented by peer-reviewed academic literature, policy reports from international organizations (UNESCO, OECD, European Commission), and recent empirical research,

particularly the Busuttil and Vassallo (2025) study that provides implementation evidence from Malta's educational context.

Analytical Framework

Drawing from the international frameworks and cross-national priorities outlined in the literature review, this study applies a structured analytical framework based on seven core ICT competencies. These competencies provide a comparative lens for examining how different national curricula conceptualise and structure ICT education.

The seven competencies used in the analysis are:

1. **Digital Literacy** – foundational skills for navigating digital environments
2. **Problem Solving and Computational Thinking** – algorithmic reasoning and systematic problem decomposition
3. **Information Management** – data handling, privacy awareness, and information evaluation
4. **Communication and Collaboration** – digital teamwork and online interaction skills
5. **Cybersecurity and Responsible Use** – digital citizenship and ethical technology use
6. **Creativity and Content Creation** – multimedia production and innovative technology application
7. **Understanding the Societal Impact of ICT** – critical awareness of technology's social, economic, and ethical implications

This framework reflects the international standards identified in the literature review and was used to code and compare the intended curricula of eight countries.

Document analysis protocol

Documents were analysed using a structured four-stage process:

Stage 1: Initial Review and Coding

- Systematic reading to identify curriculum structure, learning objectives, and assessment approaches
- Open coding to capture country-specific features and unique approaches

Stage 2: Thematic Mapping

- Content categorised according to the seven-competency framework
- Identification of gaps, overlaps, and variations in emphasis across countries

Stage 3: Structural Analysis

- Examination of curriculum organisation (standalone vs. integrated)
- Assessment and credentialing mechanisms
- Progression pathways and international alignment features

Stage 4: Comparative Synthesis

- Cross-national comparison of approaches to each competency domain
- Analysis of policy design features that distinguish different national approaches
- Application of Goodlad's (1979) framework to assess curriculum coherence

The coding process was deductive, guided by the seven-domain analytical framework derived from international digital competence standards. Documents were segmented into curriculum stages broadly aligned with lower and upper secondary levels (typically ages 11-16), corresponding to Years 7-11 in Malta. Curriculum statements, learning outcomes, and assessment guidelines served as the primary coding units. Coding was conducted independently by the lead researchers and aligned through calibration sessions to ensure consistent interpretation and thematic categorisation across countries.

Quality Assurance

Validity and reliability

Construct validity was enhanced through the use of established theoretical frameworks (Goodlad, 1979; Phillips & Ochs, 2004) and alignment with internationally recognised competency standards. The seven-domain analytical framework was validated against multiple international frameworks to ensure comprehensive coverage of digital competencies. Content validity was strengthened through systematic document selection criteria and triangulation with secondary sources, including academic literature and policy reports from international organisations. External validity considerations acknowledge that findings are primarily applicable to similar educational contexts, particularly small-state systems with comparable policy environments and implementation challenges. Inter-coder reliability was addressed through the use of a detailed coding protocol and the systematic application of the analytical framework across all documents. Key coding decisions were documented and reviewed to ensure consistency. Temporal reliability was enhanced by prioritising recent curriculum documents and noting document dates to account for policy evolution over time.

Limitations

Several important limitations are acknowledged in this study. As a document-based analysis, the research is necessarily limited to officially published curriculum materials. It cannot capture the informal implementation practices or classroom adaptations that may significantly influence actual educational delivery. While translation considerations were minimised by prioritising English-language sources and official translations, some nuances in curriculum philosophy and terminology may be lost when examining documents originally produced in other languages. The temporal dimension presents additional challenges, as curriculum documents reflect different implementation timelines across countries and may not be directly comparable in terms of maturity and refinement, with some representing well-established systems while others documenting recent reforms still in early implementation phases. Although secondary sources provide valuable insights into implementation, particularly the empirical evidence from Malta, the study cannot directly assess how policy intentions translate into classroom practice across all eight countries examined. Finally, given the study's focus on Malta as a small-state case study, findings may be most applicable to similar small-state contexts and may not readily generalise to larger, more complex educational systems with different institutional capacities and implementation challenges.

Ethical Considerations

Ethical approval was sought and obtained for records from the University of Malta Faculty of Education Research Ethics Committee (Reference: EDUC-2025-00795). While the study primarily uses publicly available curriculum documents, ethical approval ensured proper protocols for academic research involving comparative educational policy analysis.

Throughout the research process, care was taken to accurately represent curriculum policies without misinterpretation, recognising the importance of fair and precise characterisation of each nation's educational approach. The study acknowledges inherent limitations in comparative analysis across different cultural and linguistic contexts, ensuring that interpretations remain sensitive to the specific socio-educational environments in which these curricula operate. A commitment to balanced analysis guided the research, with deliberate efforts to recognise both strengths and challenges in different national approaches rather than promoting any particular model as superior. Finally, proper attribution of all sources and respect for intellectual property were maintained throughout, ensuring that the comparative analysis contributes to educational policy knowledge while respecting the sovereignty and contextual specificity of different national curriculum approaches.

FINDINGS & DISCUSSION

The findings are presented in alignment with the three research questions outlined earlier in the paper. RQ1 explores how national ICT curricula differ structurally in terms of content organisation, progression, and assessment. RQ2 compares Malta's ICT C3 curriculum with international models to identify points of convergence and divergence in policy and design, and RQ3 synthesises these insights to derive broader implications for small-state curriculum reform and policy coherence.

COMPARATIVE SCOPE AND NATIONAL APPROACHES

The diversity evident in Table 1 reflects what Phillips and Ochs (2004) identify as *selective policy borrowing*, where countries adapt international trends to fit local educational structures and cultural contexts. This pattern aligns with research by Steiner-Khamsi and Waldow (2012), who argue that successful curriculum transfer requires careful attention to institutional capacity and cultural compatibility.

Table 1. ICT curriculum names and core focus areas across eight countries

	Country	Curriculum and strategy documents	Core focus areas	Reference
1	Malta	ICT C3 Curriculum (Years 7-11) Digital Education Strategy 2025-2030	Digital literacy, coding, cybersecurity, ethics, robotics	Ministry for Education, Malta (2023); Ministry for Education, Sport, Youth, Research & Innovation, Government of Malta (2025)
2	Estonia	Education Strategy 2021-2035 (following Estonian Lifelong Learning Strategy 2020)	Programming, robotics, digital citizenship, early ICT integration	Republic of Estonia, Ministry of Education and Research (2021)
3	Finland	Finnish National Agency for Education (2014)	Multiliteracy, transversal ICT, media ethics, project-based learning	Finnish National Agency for Education (2014)
4	Australia	Australian Curriculum: Digital Technologies	Computational thinking, data systems, project-based learning	Australian Curriculum, Assessment and Reporting Authority (n.d.)
5	Singapore	National Digital Literacy Programme	Tech skills, computational thinking, cybersecurity, applied learning projects	Ministry of Education Singapore (n.d.)
6	USA	K-12 Computer Science Framework & ISTE Standards	Algorithms, programming, creativity, digital citizenship, computing impact	K-12 Computer Science Framework Steering Committee (2016); ISTE (2016)
7	Germany	Bildung in der digitalen Welt Strategy (Kultusministerkonferenz, 2016) (varies by state)	Six competency areas, including digital literacy, communication/collaboration, content creation, digital security, computational thinking, and critical analysis	Kultusministerkonferenz (2016)

	Country	Curriculum and strategy documents	Core focus areas	Reference
8	England	National Curriculum in England: Computing	Digital literacy, computer science, programming, information technology	Department for Education (2013)

The comparative analysis reveals a spectrum of structural approaches, ranging from standalone ICT subjects taught in lower-secondary education (typically ages 11–14) to fully integrated, cross-curricular models that extend into upper-secondary levels (ages 15–16). Some countries adopt flexible hybrid frameworks that allow schools to decide the level of integration based on local resources and teacher expertise. This range of structural choices supports Bray and Packer's (1993) argument that small states benefit from clearly defined, manageable curriculum structures. However, the evidence suggests that more than one pathway can achieve curricular coherence and progression in ICT education.

Cross-National Analysis of Digital Competencies

The thematic analysis across eight curricula reveals both convergence and divergence in how digital competencies are conceptualised and structured. Table 2 summarises the common trends observed across countries for each of the seven core competencies identified in the analytical framework.

As shown in Table 2, while digital literacy and responsible ICT use are universally present, other domains, such as creativity, societal impact, and computational thinking, are more variably implemented depending on national priorities and curricular models. This variation reflects what Voogt and Roblin (2012) describe as the challenge of translating global competency frameworks into nationally relevant curriculum structures. Computational thinking, in particular, stands out as a domain requiring early and systematic integration for effective skill development. Systematic reviews have shown that well-implemented CT approaches have a significant positive impact on K–12 student outcomes (Hsu et al., 2018).

Table 2. Summary of common trends across countries

Competency	Common trends across countries
Digital Literacy	Emphasis on foundational ICT skills (e.g., file management, safe usage). Integration varies between standalone and cross-curricular models.
Problem Solving and Computational Thinking	Strong presence in most curricula. Early exposure to coding (e.g., Python, block-based), robotics, and algorithmic thinking in Estonia and Singapore.
Information Management	Focus on data handling, privacy, and database use. Project-based applications in the US and Singapore; theoretical emphasis in Germany.
Communication and Collaboration	Widespread use of collaboration platforms (e.g., Google Workspace). Applied projects that are common in Finland and Singapore.
Cybersecurity and Responsible Use	All countries promote digital responsibility. Emphasis on privacy, cyber ethics, and online safety; often part of digital citizenship education.
Creativity and Content Creation	Curricula include multimedia creation, game design, and animation. Project-based tools (e.g., Scratch, video editing) that are widely used in the UK, the USA, and Finland.
Societal Impact of ICT	Growing emphasis on ethics, AI, and the digital divide. Estonia integrates e-government themes; Malta and the UK explore emerging tech impacts.

International monitoring further supports the growing trend of introducing computational thinking and digital competencies from the early years of schooling. A recent European survey found that 83% of participating countries had introduced at least some elements of digital education at the primary level, although implementation levels and depth vary considerably (Dagienė et al., 2022). Estonia and Singapore reflect this evidence in practice, showing particular strength in combining technical skills with real-world problem-solving approaches. In addition to computational thinking, the universal emphasis on cybersecurity and digital citizenship observed across all curricula aligns with research by Jones and Mitchell (2016), who developed frameworks for measuring digital citizenship competencies, and Choi et al. (2018), who argue that education should raise digitally active and responsible citizens capable of making informed decisions in a networked society.

Implementation models, however, differ. Estonia demonstrates strong integration of computational thinking from early educational stages through a compulsory standalone digital education subject. Singapore similarly introduces CT early on, but through an integrated cross-curricular approach. Both countries use applied learning approaches that combine technical skills with real-world problem-solving. This approach reflects what Grover and Pea (2013) and Wing (2017) advocate as essential for the development of meaningful computational thinking: authentic, context-rich applications rather than isolated programming instruction. The importance of cross-disciplinary integration is supported by research showing that coding experiences create opportunities to advance participatory cultures, promote interest-driven communities, and enhance students' interpersonal skills and communication, while also developing computational thinking, problem-solving, creativity, and critical thinking (Mills et al., 2025). Similarly, but through a different structure, Finland embeds digital competencies across all subjects via a transversal model. While Sahlberg (2015) argues this promotes deeper integration, it may limit opportunities to build technical depth compared to more explicitly structured approaches.

This study finds that Malta's ICT C3 curriculum demonstrates strong alignment with international trends in content innovation, particularly in its inclusion of emerging technologies such as AI, blockchain, and digital ethics. However, the analysis also highlights structural gaps in progression frameworks and the coherence of assessments. International research indicates that teacher training remains a critical challenge, with studies showing that training in primary teacher education programs is mostly limited to digital literacy even in countries that have introduced digital education-related curricula, and that 79% of teachers have some level of misunderstanding of computational thinking education (Dagienė et al., 2022). Compared to systems with clearly scaffolded learning trajectories and robust external validation mechanisms, Malta's curriculum may benefit from further development in progression tracking and moderation processes to enhance its structural comparability and long-term recognition. However, Malta's recently launched Digital Education Strategy 2025–2030 outlines several structural improvements. These include plans to strengthen computational thinking from the early years, expand professional development for teachers, provide wider access to digital devices, introduce e-assessment tools, and establish clearer systems for monitoring progress (Ministry for Education, Sport, Youth, Research & Innovation, Government of Malta, 2025). This strategic framework suggests a shift toward addressing key implementation gaps identified in this study.

Malta's ICT C3 Curriculum: Policy Innovation and Structural Challenges

Malta's ICT C3 curriculum demonstrates significant policy innovation, particularly in its reference of emerging technologies and emphasis on ethical technology use. The curriculum's coverage of artificial intelligence, blockchain, and robotics positions it among the most forward-looking national approaches examined, aligning with recent calls by Holmes et al. (2019) for curricula that prepare students for rapidly evolving technological landscapes.

However, when analysed through Goodlad's (1979) curriculum framework, important tensions emerge between intended policy goals and structural implementation supports. This disconnect reflects broader patterns identified in recent curriculum implementation research by Priestley et al. (2015) and Cotner et al. (2021), who emphasise that curriculum innovation requires simultaneous attention to teacher agency, institutional capacity, and cultural readiness.

At the intended curriculum level, Malta's C3 framework aligns strongly with international best practices identified in Table 2. The curriculum addresses all seven core competencies and incorporates contemporary themes that reflect the 21st-century digital competence requirements as outlined by Redecker and Punie (2017). The emphasis on project-based learning and ethical reflection mirrors successful approaches observed in Singapore and Finland, which constructivist learning theorists like Jonassen (1999) and more recent scholars, such as Koehler and Mishra (2009), argue are essential for meaningful technology integration.

However, recent empirical evidence reveals challenges at the implemented curriculum level. Busuttil and Vassallo's (2025) study found that while 87.5% of teachers demonstrated a clear understanding of computational thinking concepts, only 43% felt confident teaching advanced topics like artificial intelligence and cybersecurity. This implementation gap reflects what Fullan (2016) and, more recently, Hargreaves and O'Connor (2018) identify as the challenge of curriculum reform without adequate professional development and systemic support. It highlights the difficulty of translating curriculum innovation into classroom practice when educators are underprepared to facilitate new pedagogical demands.

This concern is echoed in the ISTE Standards for Educators (2017), which emphasise the importance of teacher preparation in facilitating student-centered digital learning, modeling ethical technology use, and leading innovation within their professional communities. While the ICT C3 curriculum defines ambitious student competencies aligned with frameworks such as the ISTE Standards for Students (2016), Law et al. (2018), and DigComp (Vuorikari et al., 2022), these goals cannot be realised without aligned educator competencies and sustained implementation support.

In addition, the absence of a dedicated ICT curriculum in Malta's primary years presents a significant progression challenge. Although digital literacy is framed as a cross-curricular skill in the National Curriculum Framework (Ministry for Education and Employment, 2012), there is limited clarity or documentation on how these competencies are taught or assessed in practice. This contrasts with countries such as Estonia and Singapore, where structured and progressive ICT programs are implemented from early education onwards. As Dagienė et al. (2022) argue, early exposure to digital education significantly enhances students' preparedness for secondary-level computational thinking and digital problem-solving. In Malta's context, this gap likely places additional pressure on secondary-level educators, who must accommodate wide disparities in prior knowledge while covering advanced topics. This vertical misalignment further weakens curriculum coherence and may help explain the uneven levels of teacher confidence reported in implementation studies.

These challenges are compounded by gaps in assessment infrastructure. Unlike countries such as the UK or Germany that offer formal ICT qualifications and externally moderated assessments, Malta's project-based approach lacks comprehensive tracking mechanisms and robust moderation protocols. While some moderation is in place, its limited systematisation reduces the reliability and comparability of student outcomes. As Schleicher (2018) and Lobato (2015) argue, systematic feedback mechanisms are essential for ensuring accountability, monitoring progression, and improving learning design. Although Estonia and Singapore illustrate strong vertical alignment and structured progression, these models were largely developed before the widespread integration of artificial intelligence and data science in education, underscoring the need for continual curriculum renewal rather than static imitation.

Comparative Analysis Using Goodlad's Curriculum Framework

Table 3 presents a systematic comparison of how each country addresses the seven digital competencies within its intended curricula. This cross-national analysis reveals considerable variation in curriculum scope, content emphasis, and pedagogical approaches.

The findings highlight distinct national priorities and structural choices in curriculum design. Countries like Singapore and Estonia emphasise early integration of computational thinking through applied learning, reflecting sustained policy commitment toward systematic skill development. Estonia's standalone digital education subject and Singapore's cross-curricular integration of computational thinking suggest curriculum designs that prioritise progressive skill-building and real-world application. Finland adopts a notably different approach through transversal ICT integration across subjects, emphasising problem-solving through ICT projects and design-based learning. This reflects Finland's broader educational philosophy of teacher autonomy and cross-curricular integration, though it may sacrifice technical depth for pedagogical breadth.

Other countries in the analysis, such as Australia, Germany, and the United States, illustrate how structural and systemic diversity shapes curriculum implementation. Australia provides national curricular guidance through the Digital Technologies curriculum with embedded learning progressions, while Germany and the USA reflect decentralised or federated models where curricular coherence depends on regional implementation capacity. These variations further underscore the importance of aligning curriculum ambition with implementation infrastructure, particularly in small states with more centralised systems like Malta.

Malta's curriculum stands out for its ambitious reference to emerging technologies, with explicit attention to blockchain, ethics, and advanced topics like artificial intelligence. However, when examined through Goodlad's (1979) framework using empirical implementation evidence (Busuttil & Vassallo, 2025), notable gaps emerge between intended policy goals and classroom delivery. The mixed outcomes, inconsistent depth, and limited practical application across multiple competency areas reflect what Priestley et al. (2015) term policy-practice gaps, or ambitious intended curricula that lack corresponding implementation infrastructure. This mirrors broader challenges identified in curriculum reform literature, which stress the importance of aligning content innovation with teacher preparation, infrastructure, and institutional support (Drossel et al., 2017; Tondeur et al., 2017).

The variation in curriculum approaches across countries supports the broader theoretical premise that curriculum design has direct implications for implementation capacity. While this analysis focuses on intended curricula, the Malta case study suggests that factors such as content breadth, progression clarity, and assessment structure may significantly influence implementation success and long-term sustainability.

Table 3. Comparative matrix of digital competence approaches across national ICT curricula

Competency	Malta	Estonia	Finland	Australia	Singapore	USA	Germany	England
Digital literacy	Safe use, basic tools; uneven access	Digital competence, robotics, early coding	Transversal ICT skills, multiliteracy	Device use, digital tools	Cyber wellness, foundational skills	Typing, file management, research tools	Standard software, GUIs	File management, OS navigation, productivity tools
Computational thinking and problem-solving	Coding & logic modules;	CT integrated from early years	Problem-solving through ICT projects	CT for real-world challenges	Scaffolded CT, applied learning	K–12 coding and CT pathways; progression varies by state	Robotics, algorithm design	Python programming, algorithmic thinking
Information management	Spreadsheets, databases; inconsistent depth	Privacy laws, strong practice	Managing digital resources	Project-based digital management	Project-based, industry relevance	LMS integration, inquiry-based	Data modeling, privacy emphasis	Data handling, online services
Collaboration and communication	Ethical social media use; limited collaboration	Blogs, wikis, peer feedback	Virtual learning platforms	Cloud tools, collaborative activities	Group work, applied projects	Google/MS tools, real-time collab	Wikis, collaborative tools	Team projects, shared platforms
Cybersecurity and responsible use	Covers ethics; gaps in practical knowledge	Civic ICT education, high awareness	Internet safety, responsible use	Social & ethical protocols	Cyber wellness campaigns	Digital citizenship, online privacy	Cyberbullying, data protection laws	Online safety, digital responsibility
Creativity and content creation	Animation, game dev; project-based, variable	Interactive media, e-portfolios	Design-based learning	Digital storytelling, creative coding	Creative coding, media production	Scratch, Adobe, storytelling	Design-focused activities; emphasis on technical architecture	Web authoring, graphics editing
Societal impact of ICT	Blockchain ethics; abstract, limited linkage	E-government, strong digital identity	Societal effects of technology	Ethics, equity of access	Ethics and digital responsibility integrated in civic themes	Digital divide, civic engagement	Societal risks, ethics	Legal issues, digital citizenship

Assessment Models and International Recognition

A critical dimension distinguishing national ICT curricula involves assessment approaches and credentialing mechanisms. Table 4 illustrates the broad assessment typologies identified across the eight countries examined.

Table 4. Assessment models in ICT curricula across countries

Country	Assessment format	External validation	Key features
Malta	Coursework, project-based and externally set, written exams (multiple-choice)	Internally marked; coursework moderated and retained for 5 years for possible audit	Emphasis on applied skills (e.g., robotics, digital ethics); hybrid model with 60% coursework, 40% written exam
Estonia	Competency-based model, no formal national ICT exam	No high-stakes ICT certification; digital competence is embedded across subjects and assessed formatively	Based on DigComp standards; Focus on transversal digital skills; integrated assessment through cross-curricular projects
Finland	Teacher-led, formative assessment	Trust-based; no national exams	Embedded in daily teaching; strong alignment with transversal competencies; teachers responsible for all assessment
Australia	Mix of projects and written tasks	State-level curriculum authority	Project-based assessment varies by state; integration of computational thinking in assessment
Singapore	Applied learning projects	School-based with national guidelines	Focus on real-world problem-solving; linked to Applied Learning Programmes; authentic assessment
USA	Varied approaches by district	Decentralised (school/district level) Optional external certifications	Diverse models; some external certifications (Code.org, PLTW) in select districts; no national standard
Germany	Written exams and projects	State-level standardisation	Standardised summative assessment; varies between states
England	Formal examinations with programming portfolios	National exam boards (AQA, OCR, Edexcel)	External marking and moderation, nationally recognised qualifications

As demonstrated in Table 4, Malta's assessment approach aligns with constructivist pedagogies, emphasising authentic, applied learning, an approach supported by research from Jonassen (1999) and more recently by Kafai and Burke (2014) on constructionist learning in digital environments. Malta's assessment framework includes a national examination component, alongside school-based coursework that supports the development and application of practical competencies. The written examination, which is externally set and composed entirely of multiple-choice questions, is internally marked.

Moderation processes for the coursework component have been recently introduced, marking a positive step toward greater consistency and quality assurance. While still developing, these efforts hold promise for enhancing the reliability and comparability of assessment across schools and cycles. Although schools are required to retain coursework for up to five years for potential quality audits, such audits are infrequent and do not yet constitute a systematic external validation process. As a result, concerns persist about the comparability of outcomes across institutions. More broadly, the evolving nature of external validation frameworks may also impact the future international recognition of the qualification, an increasingly relevant consideration for small states operating in a globally interconnected educational landscape.

This assessment challenge reflects broader tensions in digital education evaluation. Research by Grover and Pea (2013) and Brennan and Resnick (2012) argues that authentic computational thinking assessment requires performance-based approaches that capture student problem-solving processes. However, research emphasises that without external validation mechanisms, such assessments may lack the reliability and comparability necessary for educational accountability and student mobility (e.g., Schleicher, 2018).

Singapore's model offers a potentially relevant example for Malta, combining applied assessment with system-level guidance and coherence. Through the Applied Learning Programme (ALP), students engage in interdisciplinary, real-world problem-solving projects that are assessed at the school level using rubrics aligned with national competencies frameworks (Ministry of Education Singapore, n.d.). While no national ICT exam exists, assessment coherence is maintained through structured teacher training, implementation guides, and curricular alignment. Malta similarly provides teacher training and implementation guides for the C3 curriculum, yet the Busuttil and Vassallo (2025) findings suggest that despite these supports, significant implementation challenges remain, with teachers reporting confidence gaps in delivering advanced content. This suggests that while both countries share similar structural approaches, the effectiveness of implementation support may vary. This aligns with what Clarke and Winch (2007) and Wheelahan and Moodie (2017) describe as authentic, embedded assessment with external quality markers. Tan (2022) further explains how Singapore's assessment reforms have evolved to emphasise sustainability, professionalisation of teachers, and systemic alignment, making it a unique model for integrating applied learning with national educational goals.

The variation in assessment approaches across countries also reflects different philosophical orientations toward educational measurement. Countries emphasising formative, teacher-led assessment, such as Finland and Estonia, align with research by Hattie and Clarke (2019) and, more recently, by Heritage (2021) on assessment for learning. By contrast, countries with formal examination systems, like the UK and Germany, reflect what Stobart (2008) and Black (2015) describe as assessment of learning approaches that prioritise standardisation and external accountability. Australia demonstrates a hybrid approach, combining national standardised assessments (e.g., NAPLAN) with state-level and school-based evaluation. The USA similarly emphasises large-scale standardised testing frameworks, though recent reforms have encouraged greater use of project-based and competency-based models in some districts.

Policy Borrowing and Small-State Adaptations

Malta's ICT curriculum development exemplifies what Phillips and Ochs (2004) describe as selective policy borrowing. Policy documents and curriculum comparisons suggest the curriculum incorporates international trends evident in leading digital education systems. For example, computational thinking integration is similar to approaches seen in Estonia and Singapore, applied learning methodologies reflecting practices in countries like Finland and Australia, and ethical technology frameworks common across Nordic education systems. At the same time, it maintains distinctively local features such as the unusual inclusion of blockchain and artificial intelligence compared to other national curricula examined. This selective adaptation aligns with research by

Steiner-Khamsi (2012), who argues that successful policy transfer requires careful attention to local contexts and implementation capacity.

However, the borrowing process appears to have prioritised content innovation over structural coherence. While Malta has successfully adapted global content trends, it has been less successful in borrowing the systematic implementation supports that enable countries like Singapore and Estonia to achieve strong curriculum alignment across Goodlad's (1979) three levels. This pattern reflects what Steiner-Khamsi and Waldow (2012) identify as policy borrowing without implementation borrowing, a common challenge in educational reform.

Malta's experience illustrates broader challenges identified in small-state education literature. Bray et al. (2003) and Jules (2010) demonstrate that small states face particular tensions in curriculum reform, including limited institutional capacity and resource constraints, yet also potential advantages, including greater policy agility and more direct communication between policymakers and practitioners. Malta's experience suggests that successful policy borrowing requires what Grek (2009) and Waldow (2017) term institutional readiness, the capacity to adapt not only policy content but also the supporting structures that enable effective implementation. This gap between curriculum ambitions and implementation capacity reflects broader patterns in small-state education reform.

The comparative analysis reveals that while Malta's ICT C3 curriculum has drawn content inspiration from high-performing systems such as Singapore and Estonia, particularly in areas like computational thinking and applied digital projects, it has not fully replicated the systemic supports that underpin implementation success in those contexts. International models often combine curriculum innovation with comprehensive teacher training, progression benchmarks, and industry-aligned assessment. Malta's approach places strong emphasis on curricular content, while work is still underway to establish a fully aligned structural foundation. This ongoing development may contribute to some differences between policy ambition and implementation capacity.

Implications for Small-State Digital Education Policy

The comparative analysis reveals several key insights for small-state digital education policy, building on recent research in comparative education and small-state studies. Most critically, the gap between Malta's experience reinforces a broader insight for small-state education systems, in that ambitious curriculum innovation demands sustained investment in teacher development and institutional support. As Tondeur et al. (2017) and Fullan (2016) note, success hinges on more than content; it depends on the readiness of the system to implement it.

However, this study also reveals promising pathways forward. Smaller educational systems like Singapore demonstrate how locally-relevant curriculum innovation can be combined with systematic assessment frameworks that maintain international comparability. This approach aligns with research by Clarke and Winch (2007) and Wheelahan and Moodie (2017) on effective vocational education pathways, suggesting that Malta needs not abandon its innovative content to achieve greater structural coherence.

Central to this balance is assessment coherence. While Malta has recently introduced external moderation for coursework, the system is still evolving in its capacity to provide comprehensive, standardised tracking of student outcomes. This contrasts with more established and systematic approaches in other countries, where assessment frameworks combine formative classroom practices with robust external validation. Research by Schleicher (2018) and Black (2015) emphasises the importance of balanced assessment systems that support both authentic learning and comparability across contexts, a goal that Malta's emerging hybrid approach could gradually help achieve.

Malta's experience also sheds light on broader patterns of selective policy borrowing. While its ICT C3 curriculum incorporates globally recognised themes such as computational thinking and digital citizenship, the implementation trajectory reveals the importance of aligning curriculum innovation with systemic capacity. This reflects what Waldow (2017) describes as a core challenge in policy

transfer, that innovative curricular ideas must be matched by institutional readiness and sustainable support structures. Rather than being a uniquely small-state issue, Malta's case illustrates a wider policy phenomenon in which globally inspired reforms encounter friction in local implementation contexts.

Toward a Dual-Pathway Model for Malta

Based on the comparative analysis and recent research on curriculum design and implementation, this study proposes a dual-pathway approach for Malta's ICT education that builds on the ICT C3 curriculum's strengths while addressing identified structural gaps.

The proposed model distinguishes between two complementary phases that acknowledge different learning priorities across the secondary cycle. The foundational phase (Years 7-9) would preserve and strengthen Malta's innovative approach to digital education, emphasising creativity, ethics, and emerging technologies through formative assessment and project-based learning. This approach aligns with research by Kafai and Burke (2014) and Brennan and Resnick (2012) on constructionist learning approaches that promote deep engagement with computational concepts through exploration and authentic problem-solving.

The consolidation phase (Years 10-11) would introduce systematic validation mechanisms while maintaining the innovative foundation established in earlier years. Specifically, while the foundational phase emphasises formative, teacher-directed assessment for exploratory learning, the consolidation phase would institute more rigorous external moderation processes and standardised rubrics, strengthening assessment coherence through enhanced moderation processes, standardised assessment rubrics across schools, and clear competency benchmarks that align with tertiary education requirements. Research by Clarke and Winch (2007) and Wheelahan and Moodie (2017) supports the use of such progressive approaches as effective in balancing local innovation with systematic quality assurance.

This approach reflects international patterns identified in the comparative analysis, where education systems balance local relevance with structured development. It supports Priestley et al.'s (2015) emphasis on teacher agency and contextual adaptation, enabling educators to shape implementation while maintaining professional alignment.

Importantly, the proposed model responds to what Livingstone (2012) and Selwyn (2016) identify as key gaps in digital education: the absence of systematic tracking and progression pathways. By combining rich, innovative content with more structured guidance, Malta can strengthen both its internal consistency and its international comparability, without compromising the creative ethos of the ICT C3 curriculum.

Limitations and Future Research

This study acknowledges several important limitations that suggest directions for future investigation. As a document-based comparative analysis, the research is necessarily limited to officially published curriculum materials and cannot capture implementation practices, classroom adaptations, or student learning outcomes across all countries examined. While translation considerations were minimised by prioritising English-language sources and official translations where possible, some nuances in curriculum philosophy and terminology may be lost when examining documents originally produced in other languages. Additionally, the temporal dimension presents challenges, as curriculum documents reflect different implementation timelines across countries, with some representing well-established systems and others documenting recent reforms that are still in early implementation phases.

The study's heavy reliance on the Busuttil and Vassallo (2025) study for evidence of Malta's implementation is valuable, but it represents a single empirical source that cannot fully capture the diversity

of implementation experiences across Malta's educational sectors. Moreover, the absence of systematic student outcome data means the study cannot directly assess the attained curriculum level that Goodlad's framework emphasises, limiting conclusions about actual learning effectiveness.

Future research should address these gaps through mixed-methods approaches that combine policy analysis with classroom observation and student outcome measurement. Longitudinal studies tracking student progression through different ICT curriculum models would provide crucial evidence for policy refinement, particularly examining how students transition from school-based ICT learning to tertiary education or employment in digital sectors, a dimension identified by van Laar et al. (2017) and Binkley et al. (2011) as crucial but underexplored. Such studies should follow cohorts for at least five years post-graduation to capture meaningful data on career trajectories.

The small-state focus of this analysis suggests that findings may be most applicable to similar contexts with comparable institutional capacities and policy environments. However, the seven-domain analytical framework developed here could be extended to larger educational systems with appropriate adaptation for different cultural and administrative contexts. Research by Crossley (2019) suggests that small-state insights may be increasingly relevant as larger systems grapple with similar challenges of balancing local innovation with global compatibility in digital education reform. Future comparative studies could test this framework's applicability across diverse system sizes and examine whether the policy design features identified here predict implementation success in different national contexts. For small states like Malta, this dual-pathway model illustrates how digital education reform can advance both national priorities and global compatibility through flexible systems that support coherence, continuity, and inclusive progression.

CONCLUSION

This conclusion draws together the findings in relation to the three research questions, highlighting how the analysis contributes to understanding curriculum coherence, comparative policy adaptation, and small-state innovation in digital education. The comparative policy analysis has highlighted both the potential and complexity of Malta's ambitious digital education reforms. By applying Goodlad's (1979) curriculum theory and Phillips and Ochs' (2004) policy borrowing framework, the study illustrates how small states can meaningfully engage with global education innovation while navigating unique structural and implementation challenges.

Malta's ICT C3 curriculum demonstrates a well-conceived policy design, integrating international priorities such as computational thinking, ethical digital citizenship, and emerging technologies, including artificial intelligence, blockchain, and robotics, within a locally grounded framework. Rather than portraying Malta as more innovative than other systems, the findings show that its approach reflects strong policy responsiveness within the constraints of small-state capacity. This positions Malta among the more forward-thinking national approaches to digital education, offering a valuable contribution to the evolving global discourse on digital competence.

However, the analysis also underscores a critical lesson for curriculum reform, where innovation at the policy level must be matched by structural coherence in implementation. While Malta shows strong alignment at the intended curriculum level, significant gaps remain in areas such as teacher preparedness, progression tracking, and assessment moderation, elements that distinguish it from systems with stronger curriculum integration across design and delivery.

The seven-domain analytical framework developed in this study provides a replicable tool for examining digital education curricula across contexts, and its application here has revealed meaningful structural patterns with implications beyond the Maltese case. These findings contribute to the literature on both comparative curriculum studies and small-state education reform.

For small-state policymakers, the findings suggest that effective reform requires more than policy ambition; it necessitates deliberate investment in implementation infrastructure. The proposed dual-

pathway model, which combines formative and exploratory learning in the early secondary years with more structured and moderated assessment in later years, offers one possible approach for enhancing alignment without compromising innovation. Its effectiveness, however, remains contingent on real-world implementation and should be further evaluated through empirical classroom-based studies.

Future research could expand this analysis by examining how curriculum policy features translate into teaching practices and student learning trajectories through longitudinal, mixed-methods designs. Moreover, investigating how AI literacy, data ethics, and sustainability competencies evolve in small-state curricula would deepen understanding of emerging digital education priorities.

Ultimately, Malta's experience underscores a broader insight: in the digital age, successful curriculum reform depends not only on the content of change, but on the systems that support its delivery. As education systems worldwide strive to equip learners for an uncertain technological future, small states like Malta offer important lessons, not only as policy borrowers but as testbeds for innovative approaches that bridge global trends and local educational realities.

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