



Mobilising teacher education in Ireland: The MiTE ecosystem for learning by design

Title	Mobilising teacher education in Ireland: The MiTE ecosystem for learning by design
Author(s)	Ó Grádaigh, Seán; Mac Mahon, Brendan; Ní Ghuidhir, Sinéad; Hall, Tony
Publication Date	2020-06-11
Publisher	Bloomsbury Academic

Mobilising Teacher Education in Ireland: The MiTE Ecosystem for Learning by Design

*Séan Ó Grádaigh, Brendan Mac Mahon, Sinéad Ní Ghuidhir & Tony Hall
School of Education, National University of Ireland, Galway, Ireland*

Abstract

This chapter outlines an innovative and emergent multilevel initiative in the School of Education, National University of Ireland, Galway, focused on *infrastructuring* educational transformation in teacher education through the use of mobile learning technologies. We illustrate how the initiative has grown from an innovative programme locally, into a significant, foundational contribution to both a well-established international conference and emerging international network of mobile teacher educators. The initiative, which now encompasses the first international conference in the field (*MiTE: Mobile Technology in Teacher Education*), originated and was developed through the Máistir Gairmiúil san Oideachas (which translates in English as Professional Master of Education), a national flagship postgraduate degree that prepares teachers to teach a wide range of curriculum subjects (e.g. humanities, sciences, mathematics, etc.) through the medium of the Irish language in Irish second-level schools. We use MiTE in this chapter to describe the innovative ecosystem as a whole, encompassing the internal infrastructuring of the local mobile teacher education programme, and external infrastructuring through the MiTE Conference, EU DEIMP Project and IMoLeNTE International Network of mobile teacher educators. The chapter illustrates how multi-level infrastructuring (Penuel, 2019) – underpinned and informed by key theoretical frameworks (e.g. iPAC) – can be crucial and helpful to us as educational technology designers and innovators; not only to initiate impactful change, but critically to promote and sustain innovation with mobile technology in teacher education.

Introduction

Mobile learning in teacher education is a frontier but developing field of educational technology research (Baran, 2014). This chapter offers insights into, and lessons learned from systematising the deployment of mobile learning in teacher education in the School of Education at the National University of Ireland, Galway (NUIG).

Infrastructuring is a term used by Penuel (2015; 2019) in design-based implementation research (DBIR), to describe multilevel initiatives that endeavor to support truly transformational innovation in education, particularly where key stakeholders, principally teachers, are engaged in collaborative design (co-design). To effect and sustain meaningful, impactful change and innovation in education, a focus on co-design – with and for learners and educators – is imperative. Consequently, according to the DBIR paradigm, for change to be lasting and transformative, it must be initiated, propagated and sustained at multiple important levels. These can include, among others: the social, curricular, technological, political and material (e.g. built/physical learning environment) aspects that formatively influence the equity and quality of learning in classrooms, schools and other complex, naturalistic educational contexts.

However, it can be argued that innovative educational technology initiatives can often happen in ‘splendid isolation’, in niches or specialised contexts, and the crucial ‘joining-of-the-dots’ that is needed at multiple levels does not take place; thus rendering the innovation limited in its scope and sustainability.

We present in this chapter a long-term vision and integrated endeavor to create lasting and impactful educational change with technology, through connected and complementary internal and external initiatives to embed and advance mobile technology in teacher education.

First, in terms of local impacts at the *proximal* (McKenney & Reeves, 2018) level, we outline the deployment of mobile learning for teacher education in the School of Education at the National University of Ireland, Galway (NUIG), particularly within the Máistir Gairmiúil san Oideachas (MGO), the national flagship programme in Ireland for teacher education through the medium of the Irish language.

The chapter discusses how mobile technology has been systematically designed and deployed to support all key professional educational aspects of the MGO programme, with a specific focus on pre-service teachers’ learning by design (e.g. Mac Mahon, Ó Grádaigh & Ní Ghuidhir, 2018). We illustrate how a bespoke ecosystem is being developed to support learning, teaching and assessment throughout this professional teacher education programme, which has resulted in the MGO becoming the first European programme to be awarded Apple Distinguished Programme, (and also uniquely achieving this accolade on three successive occasions), in 2014-2015; 2016-2018; and 2018-2021. In November 2018, the MGO programme, School of Education, NUI Galway was awarded the ADP (2018-2021) for an unprecedented third time. The ADP is Apple’s international, gold standard for mobile and technology-rich innovation in education and teaching, with application for the ADP Award by invitation only: “Apple Distinguished Schools are centres of leadership and educational excellence that demonstrate Apple’s vision for learning with technology — and we believe they are some of the most innovative schools in the world” (Apple Education, 2019).

As well as an enumeration of the process of mobile learning design in context, a key goal is to propagate out, publish and share the local MGO innovation, and network with cognate, innovative initiatives in mobile teacher education internationally.

Consequently, we reflect on the development of the MiTE (Mobile Technology in Teacher Education) international conferences, which originated from the MGO programme, and were conceived of and led by the first author; and other key aspects of external infrastructuring, namely the EU DEIMP (Designing and Evaluating Innovative Mobile Pedagogies) Project and IMoLeNTE (The International Mobile Learning Network for Teachers Educators), which are helping significantly to mobilise teacher educators’ practice and research in the emerging field of mobile learning design.

In this chapter, we conceptualise MiTE in terms of Penuel’s usage of the terminology of infrastructuring in DBIR. The use of the gerund, infrastructuring is noteworthy; as a verbal noun it connotes both the fact that there is now an

established, extant systemic use of mobile learning in teacher education within our school, but also that this ecosystem is also still emerging and taking shape, crucially being informed by key international developments including the annual, international MiTE Conference (2019 marked its fifth instantiation), European DEIMP Project (2017-2020) and, relatedly, the international IMoLeNTE Network.

ICT and mobile education – challenges and potential

The chapter commences by briefly outlining the policy context for educational technology; and critically how the lack of effective engagement of teachers – as co-designers - in educational innovation is highlighted, as a major barrier impeding the systemic use of technology to enhance equity and quality of learning in schools. Building from this, the chapter outlines the concepts and ontological frameworks that have informed the development of the MiTE ecosystem; these include iPAC, TPACK and SAMR. Thirdly, we report pre-service teacher's feedback and reflections on the infrastructure for mobile innovation in teacher education in Ireland.

A very significant factor in the successful adoption and implementation of educational innovations and technologies, particularly in the local, practice context of classrooms and schools, is teachers' capacity and willingness to use educational technology – on a sustained and systematic basis - to enhance teaching, learning and assessment.

In 2018, the EU again reemphasised the pivotal role that teachers play in ensuring educational technology impacts effectively on learning in classrooms and schools, and how education and educational leaders need compelling and clear examples and scenarios of the effective use of ICT in education: "It is most effective and sustainable when embraced by well-trained teachers and embedded in clear teaching goals" (p.2). Published in 2018, the EU's *Digital Education Action Plan* focuses on three priority areas, with the first two being particularly apropos in terms of the mobile learning innovations outlined in this chapter. These target: (1) increasing the effectiveness of ICT use for learning and teaching; and, relatedly, (2) developing and promoting ICT competences and skills.

Historically, a major barrier impeding the successful adoption of educational technology in classrooms and schools has been the lack of support for teachers to address the important socio-technical challenges they can encounter in deploying ICT successfully in their classrooms. Teachers require continuous professional development (CPD) that enables them to understand and work effectively with the pedagogical – as well as technological – implications and requirements of introducing innovations – such as mobile learning – in their classrooms.

McKenney (2011) outlined key principles for the specific types of engagement and support teachers need, to help them to implement effectively educational technology in schools. These four salient principles are: *value-added (better than status quo)*; *clear (participants can envision their involvement)*; *compatible (with values, beliefs, surrounding educational context/system)*; and *tolerant (withstands the natural variation of actual use)*. Once these principles are in place, it is

possible to create a productive space for real and impactful, collaborative change with teachers; what McKenney calls a *zone of proximal implementation*. A recurring cause of failure historically for sustainable educational technology has been the lack of effective, participatory involvement of teachers in its conceptualisation, deployment and development in schools. Further, technology has often been foregrounded, without sufficient regard for the inherent socio-technical infrastructure of digital educational innovation, which necessarily entails significant pedagogical as well as technological aspects.

Learning by co-design in mobile teacher education

While the increasing mobility of technology creates significant potential to enhance education, learning and teaching, it is erroneous to think that simply introducing innovative mobile technology into teacher education will necessarily lead to transformative change. Melhuish & Falloon (2010, p.2) noted how it is: “deterministic [to] assume that the presence of technologies will act as a catalyst for fundamental and sustained change and improvement”.

Learning collaboratively and by design, however, can help significantly to embed and situate technology in educational practices, which can then mobilise and maintain innovation. Highlighting the potential of learning by design – as a dynamic, creative and generative context to promote innovative practice - Koehler et al (2011, p.151) emphasised how, “We argue that one of the best ways to learn about educational technology is to design educational technology”.

Critically, learning by design challenges us to engage actively and creatively with the key socio-technical dimensions of teaching today, especially where these are supported by innovative digital media and resources: “Through the design process, learners must constantly work at the nexus of content (what to teach), pedagogy (how to teach it), and technology (using what tools).”

Indeed, mobile technology holds the promise of truly transformative innovation in education, fundamentally through foregrounding and promoting social interactivity and connectivity in learning; the range of interactive apps and tools available through mobile devices and platforms today; and of course, the potential to change and augment significantly pedagogical practice in schools (and other learning environments) by reshaping the space-time boundaries of how, when and where learning takes place.

However, participatory learning by design is imperative to engage teachers creatively and productively with mobile technology in order to enact change and innovation in their teaching practices. Critically, the US Department of Education’s Office of Educational Technology (2016) has highlighted how participatory and shared innovative practice – between pre-service teachers and faculty – is important to support optimal use of educational technology, notwithstanding pre-service teachers’ familiarity with, and usage of technology outside the ITE context:

It is inaccurate to assume that because pre-service teachers are tech savvy in their personal lives they will understand how to use technology effectively to support learning without specific training and practice. This expertise does not come through the completion of one educational technology course separate from other methods

courses but through the inclusion of experiences with educational technology in all courses modeled by the faculty in teacher preparation programs.

As a consequence, the rationale for the introduction of mobile technology within the MGO initial teacher education programme was to answer a number of salient, interrelated questions. Taking learning by design as a key, orienting focus, and the iPad as the principal digital tool, the goal was to introduce innovation programme-wide, and support and sustain innovative change and practice in initial teacher education. Thus, the key questions to emerge included:

- *How can the iPad support student-teachers' professional learning and teaching on the MGO programme?*
- *What is the impact of the iPad on student-teachers' approaches to teaching, learning and assessment?*
- *What is the impact of the iPad on our own practice as lecturers and university placement tutors (who support and assess student-teachers' performance during their teaching placement experiences in schools)?*

As well as a participatory, learning-by-design approach, the introduction of mobile learning was also undertaken in a principled fashion, underpinned by key contemporary concepts and theories of mobile learning in education and teacher education.

Key conceptual frameworks for mobile learning in teacher education

In design research in education, it can be helpful to draw on multiple concepts and theories of learning, innovation and technology, as the challenges of educational change are typically conceptualised as involving “multiple dependent variables” (Barab & Squire, 2004, p.3), or ‘many actors and factors’. As a result, no one theory is likely to be sufficient to illustrate the complexity and diversity that characterise educational innovation; drawing on a range of concepts can potentially lend a richer description than can relying on one alone. Multi-ontological frameworks are often essential to understand the mix of different variables that matter when we try to innovate and change educational practice, particularly when we talk about the challenge of infrastructuring, where change and its impacts are likely to be multifarious and multi-level. Drawing on a range of relevant concepts and theories can help us to understand the complexity and challenge of the problems of educational change and innovation in a more comprehensive manner, hopefully contributing to a greater chance of success with the educational technology.

A principled approach to mobile co-design with pre-service teachers

Three key theories have prevailed in the design thinking underpinning the development and refinement of the MGO mobile teacher innovation.

These are iPAC, SAMR and TPACK.

Originally developed in 2012 by Kearney, Schuck, Burden & Aubusson, the iPAC Framework encompasses three principal constructs for illustrating the specific

innovative contributions of mobile technology in terms of mediating and supporting learning, or *signature pedagogies* that make mobile learning distinctive. On the higher level, these include *Personalisation; Authenticity; and Collaboration*. On the operational level, the overarching constructs are broken down further into constituent sub-constructs, for example: Personalisation, which includes: *instant feedback, learner-negotiated, own place, own pace*, etc. The mobile technology innovation within the MGO infrastructure reflects the iPAC constructs; the pre-service teachers engage in authentic, collaborative and personalised professional learning, supported and enhanced by the mobile technology. They use the iPad across all key aspects of their teacher education programme. A key principle of the MGO programme design is ubiquity; and because the student teachers use the technology every day, in an integrated fashion in their programme, it becomes a habitual aspect of their professional learning and development. Significantly, this is in contrast with more traditional/typical design of teacher education – where educational technology is taught in an isolated fashion – and it is up to the teachers subsequently to make sense of the use of ICT within their respective subject disciplines. The authentic integration of iPad into all aspects of the MGO pre-service teachers' professional development and learning has had a considerable impact in supporting potentially transformational learning with technology, where the student teachers concurrently develop their skills in using mobile educational technology, but also deepen their understanding of TPACK and the possibilities for innovation with technology within their respective subject teaching area. Furthermore, the integration of the technology throughout the programme has enabled collaborative design of innovation, challenging both the student teachers and faculty to navigate together a new direction for teacher education. In sum, the pre-service teachers become co-designers through the mobile technology. For example, the students undertake collaborative, multimedia assignments, e.g. shared iBook development, using Apple Pages and iBooks Author; and synchronous/real-time mobile school placement through iPad, enhanced with instant/immediate feedback from faculty.

The MGO programme endeavours to embody the principles of *Authenticity; Personalisation; and Collaboration* through iPAC signature pedagogies, made possible by the authentic, programme-wide integration of mobile learning technology.

The SAMR (Puentedura, 2015) model describes the potential impact of educational innovation, moving from *enhancement*, where the technology facilitates substitution and augmentation of existing practices, to *transformation*, where the innovation truly and significantly modifies and redefines learning, teaching and assessment, (in ways that would be inconceivable without the introduction of the technology). The focus of the development of mobile learning technology within the MGO programme has been to promote and sustain truly transformative practice in initial teacher education, exploiting the novel and unique affordances of the iPad and supporting educational technology architecture, e.g. iTunesU.

The third major theoretical orientation in the MGO and MiTE innovation is TPACK, developed by Koehler & Mishra (2009), which extends and builds on

Shulman's (1987) original PCK Model. TPACK specifically supports our conceptualisation and understanding of the key domains of teachers' professional competence, specialist subject matter, and pedagogical and technological knowledge, which they need to teach effectively with educational technology. Therefore, a key focus of the MGO is to develop pre-service teachers' TPACK so that they not only understand their subject area deeply, but also how new technology can be integrated within their teaching to support authentic, collaborative and personalised learning that is potentially transformational in its scope and impact.

Overview of research evaluation study

But how are pre-service teachers' experiencing the internal infrastructuring of the local, innovative teacher education programme, mediated and enhanced by mobile learning technology?

Having introduced the iPad into all core aspects of the MGO programme: school placement supervision and feedback; reflective practice; and subject teaching innovation, a systematic research evaluation methodology was deployed, to ascertain the pre-service teachers' experiences and perspectives regarding the use of the iPad and mobile technology. All thirty-eight student teachers in the MGO participated in the purposive evaluation study, which was designed both to highlight the impacts and constraints of the mobile learning innovation, while also supporting iterative design and refinement of the teacher education programme itself.

A mixed range of methods was used to determine the impact and effectiveness of the mobile learning innovation in Irish initial teacher education. These methods included: focus groups; questionnaires; audio & video capture and reflections; resource design & development; and ethnographic style observation, including the recording of field-notes.

Summary of findings – at the local level

Overall, at the level of the local programme, the research evaluation study highlighted both the challenges and affordances created by the integration of the mobile learning technology within initial teacher education.

Students reported significant benefits in terms of the organisation of their learning, e.g. lesson plans and resources were easily accessible through Dropbox, and this feature was especially useful on school placement practice experience, where the pre-service teachers had easy portable access to course materials, which could be with them always, and which proved much easier to carry around on an iPad rather than a sizeable physical folder. In general, the pre-service teachers liked the *economical teacher kit* that using the iPad afforded them. Also, the mobile technology helped to create new opportunities and spaces for learning, offering immediate access to teaching and learning resources, irrespective of the MGO students' location. Further, it provided an excellent portable research tool, which enabled the pre-service teachers to extend and enrich their knowledge through immediate access to information referenced in lectures and workshops. Through the cloud architecture, they could also more easily share access to their lesson plans with their school placement tutors

(faculty assessing them on their classroom teaching), which supported better monitoring, and immediate and ongoing feedback on their lesson plans and related resources.

Enhanced opportunities were also created by the technology for peer learning. The communal cloud storage files created by the student teachers could be shared and further edited/re-edited; the pre-service teachers could take the resources, adapt and redesign them; thus putting their own stamp on them. In this, they reported how they were engaging deeply with their teaching subject, potentially learning things about their subject area, which they may not have known before; plus they also had a set of new, bespoke and interactive teaching resources. Through the iPad, the pre-service teachers could use Facetime and Facebook for support and advice on what did/did not work in the classroom. The affordances of the mobile technology were very evident, especially in terms of impact on pedagogy. Pupil motivation and engagement were enhanced through using creative apps, such as Keynote, Pages, Playtube and iTube. For example, in languages class, one of the MGO students used Facetime to connect their pupils with a class in France, (which was easily facilitated through the iPad).

Further pedagogical benefits included: video recording of student activities, which could support augmented feedback, and pupils making multi-media presentations, which could be peer-assessed. The Zoom facility on the iPad could also be used in science class as an interactive digital microscope, while apps like Explain Everything and Puppet Pals brought enhanced interactivity and creativity to lessons.

Pre-service teachers also reported in the evaluation research how the iPad also significantly enhanced their reflective practice. The student teachers were required to complete written as well as video recorded reflections, highlighting key moments and stories of learning emerging from their school-based teaching practice. Students unanimously reported that they found the critical video reflection most helpful; the portfolio of video recordings on their iPad also enabled them to review, chart and see their progression as early career practitioners.

There were also ancillary, school-wide benefits to the use of mobile learning technology by the MGO students. Principals and staff in the pre-service teachers' placement schools were often impressed, particularly with the innovative TPACK resources and interactive apps.

On the negative side, however, it was reported how extant school culture could prevail negatively upon the innovative use of mobile technology in schools. Some teachers took the view of 'who does she think she is?' and 'we didn't have iPads, all we had was a marker', in respect of the pre-service teachers' use of the iPad in class; and teachers could also be more concerned with drilling students to complete exam papers, without using innovative teaching, nor technology, to promote student interest and understanding.

A particularly powerful aspect of the mobile learning innovation was not the technology alone, but rather the technology being used to support collaborative

learning by design. Significant evidence in the evaluation data, reported by pre-service teachers, illustrated how the creative use of the iPad – supported through the MGO programme – helped to prompt and enhance the students to think creatively, collaboratively and innovatively about their teaching subject. For example, the pre-service teachers remarked how ‘all of us learning from one another’; ‘I found better ways to teach it’; ‘I was learning about the syllabus as well as ways to teach’; ‘thinking of my own class and tailoring resources’; and ‘that process helped to bring everything together’. These comments really underscore the significant impact the mobile learning innovation had on the MGO students’ TPACK, and how collaborative design through the iPad helped to deepen both their understanding of their subject area, as well as of interactive, technology-enhanced ways of teaching.

Significant challenges also emerged in the analysis of the research data, particularly regarding the constraints of school IT infrastructure, e.g. quality of Wi-Fi coverage, on the use of iPad and related innovative technology. The pre-service teachers also remarked on the significant investment of time needed to create interactive, bespoke resources for class, and pupils expectations’ that if learning was interactive and enjoyable it couldn’t be *serious*.

The research at this point highlighted, not so much a ‘digital divide’ as a ‘digital *use* divide’, between passive and active use of technology. Critical to the success of innovation with mobile learning technology in education is for the emphasis to be on promoting and supporting pupils’ collaborative design and creativity.



Figure 1. Mobile teacher education: digital *use* divide

Mobile learning post-initial teacher education

A follow-up study sought to determine the MGO NQTs’ experiences having graduated from university and entered the teaching profession in Ireland. Key questions included: Having completed the innovative MGO programme, how were they experiencing their first year in the teaching profession? In particular, were they still using the iPad as frequently and widely in their teaching practices, to promote and support creativity and collaboration in their classroom?

A follow-up questionnaire was administered to the 38 newly-qualified teachers (NQTs), supplemented by interviews with 12 purposively selected participants

from the group (all employed as teachers). Ireland's *Digital Strategy (2015-2020)* specifically notes the importance of digital technology across the so-called *three i's* of the teacher education continuum: initial, induction and in-service, and how, "Use of ICT for teaching, learning and assessment is embedded at each stage of the continuum of teacher education, i.e. Initial Teacher Education, Induction and Continuous Professional Development" (p.29).

Of the whole group, 97% of the graduated MGOs were currently teaching. 58% of respondents were teaching in an Irish medium context, while 23% were teaching in contexts where pupils and schools had 1:1 iPad schemes. All of the 38 NQTs responded.

A particularly noteworthy finding from the follow-up study was that, although there was variability across the ICT access, resources and infrastructures of the NQTs' schools, they were being seen as agents of change by their teaching colleagues and school principals. Coming from the deep and innovative foundation they received in educational technology through the MGO programme, 60% of the NQTs were regarded as experts by staff, while 68% had provided ICT advice to colleagues, and indeed 26% had provided some form of in-service in school.

77% had also reported sharing resources with fellow teachers (e.g. through Dropbox).

On entering full-time teaching, all of the NQTs continued to use the iPad they had purchased at the start of their initial teacher education programme.

48% were still using the iPad for planning and administration, and 74% reported using the technology for teaching, learning and assessment, with 52% using it every day or almost every day. 81% of respondent MGOs were still in contact with their classmates, with 39% actively sharing resources. In their use of the mobile technology for teaching and learning post-ITE, practice ranged from substitutive to transformative.

For example, at the substitutive level, the MGO NQTs reported simply making multimedia presentations through the iPad; while at the truly innovative and transformative level, excellent practice in terms of TPACK was evident, e.g. pupils making multimedia presentations of experiments – with voiceovers - and uploading/sharing videos (through Google Drive).

The MGO NQTs reported significant benefits to learning and assessment from the use of mobile technology in the classroom. However, barriers relating to culture and school context, and over-emphasis on 'traditional', rote learning and examinations, which were evident in school placement, persisted. Furthermore, the NQTs strongly conveyed the clear need for CPD among practicing teachers, with 93% reporting they had received no technology training as part of their induction.

We now conclude this section of the chapter by selecting and highlighting insightful quotes provided by the MGOs in the NQT follow-up study. These quotes afford us a very useful, critical insight into the barriers and challenges that remain in expanding and propagating the zone of proximal implementation

generated by innovative teacher education programmes, like NUI Galway's MGO, out into the education system as whole.

Firstly, the endemic *culture of notes*, with its focus on summative, terminal examinations, prevailed negatively upon the NQTs' ability to extend the innovativeness of the teacher education programme into their classrooms.

'The culture of notes in conflict with what I learned last year on course about technology'

'6th years are looking at me and saying "Why are you not giving us notes? Why are you trying to do fun stuff with us?" They are looking for notes, notes notes'

Relatedly, there is pressure from parents, school management and the pupils themselves, centred on exam performance, especially in the 3rd and final years of secondary schooling, when the Irish education system is preoccupied with preparation for high-stakes, state examinations.

'Particularly with 3rd and 6th yrs. there is pressure from parents, principal and students to achieve good grades and there is a formula in each subject regarding the things you should be studying. So sometimes I just focus on that. We use the exam papers, they practice, I correct. You have to do this because you have to do the State exams. You have no choice and there is nothing in relation to presentations or student creativity taken into consideration, in my opinion. 6th yrs. want points [for college entry] and there is little you can do about it.'

The NQTs noted the significant potential of the iPad as a powerful digital tool to enhance interactivity, engagement and learning in class, but how the overarching educational system and overemphasis on rote learning; perfected, pre-prepared answers; and points for college entry, limited possibilities for mobile learning in the classroom.

'I prefer when I am using the iPad in class and it is interactive and everyone is participating but the points system is in conflict with this. They know that teachers in other schools around the country are giving perfect answers that students are learning off by heart. If we want A1s we have to do some of that also and I don't think it is a good thing.'

'They want notes and results only...students get high marks without group work ' I could go in with or without the iPad and have the same impact on their learning...a great resource but without the relationship with students you are going nowhere'

These key quotes from the MGO students are illustrative of the wider cultural barriers in the educational system that currently constrain and impact significantly on the infrastructuring of innovative mobile learning with technology beyond the ITE context.

External MiTE infrastructuring

A key aspect of the MiTE (Mobile Technology in Teacher Education) infrastructure at the NUI Galway is the MiTE Conference. A pioneering development in Irish and international teacher education, which originated from within the MGO, initiated and chaired by the lead author on this book chapter, MiTE has grown to become the preeminent, flagship international conference in the emerging and exciting domain of mobile technology in teacher education. While the MGO programme constitutes the crucial internal infrastructuring for mobile innovation in teacher education locally and nationally, the MiTE Conference critically has provided the basis for connecting with, and indeed developing a wider international community and cadre of researchers and practitioners, committed to the deployment of mobile technology in teacher education. The external MiTE infrastructuring – particularly through the conference - is a highly significant dimension of the extant and ongoing design and promotion of mobility in teacher education.

We now outline some of the key design features of the MiTE Conference, and how it has emerged and evolved since the inaugural conference, which was hosted in Galway in January in 2015. By overviewing the provenance, history and development of the annual MiTE Conference in this section, we hope to be able to illustrate how the dynamic field of mobile learning in teacher education is changing, while highlighting the key contribution of the international networking that has emerged from MiTE to the broader, overall infrastructuring of innovations with educational technology.

Conceived of, and chaired by the lead author, the MiTE Conference emerged directly to address a significant gap in the field as well as bring together a growing and emerging community of practitioners and researchers, interested in the use of mobile technology in teacher education. A key part of the rationale was also to position and augment the innovative work being undertaken within the MGO programme and School of Education, NUI Galway.

In 2015, there did not exist a coherent, focused international research community exploring and examining the potential and role of mobile devices, apps and architectures, specifically in the context of teacher education. Also, the technology had advanced and evolved considerably since the early days of m-learning, but there was no single community examining m-learning in the key educational-professional domain of teacher education. This was especially important at the time, because it is well established in the research that for innovations to persist and take hold in education, including the integration of technology, teachers must be properly supported and collaborated with as educational professionals, in order to embed effectively innovative practice across the *three i's* of the teacher education continuum: initial, induction and in-service/professional development (PD).

The creation of an international conference for teacher educators represented a crucial, landmark development at a key time for mobile learning, as highly usable, portable and adaptable apps and technologies were emerging, led by and given new impetus by the development of the Apple iPad.

As the first, foundational conference in the field, it is noteworthy to discuss how the MiTE Conference was originally, and still is, organised. The first day is the Academic Platform, where papers reporting peer-reviewed, research-oriented

papers (long, short and poster) are presented and discussed in parallel sessions. The second day, Practitioner Platform provides the opportunity for delegates to engage in interactive demonstrations/showcases and workshops, which help directly to develop attendees' TPACK competences in how innovative mobile technology – including but not exclusively the iPad – can be used to enhance learning, teaching, and assessment.

For example, in the Academic Platform, leading, frontier researchers in the field, e.g. Prof. Kevin Burden and Dr. William Rankin, have provided signature keynotes and papers on the big themes and issues emerging for the community in terms of the design and evaluation of mobile technology in teacher education. The second day of the conference, Practitioner Platform, complements the first day by engaging delegates directly with state-of-the-art, 'bleeding edge' technology – showcased and organised by vendors and suppliers - from drones and robots to apps and innovative software architectures for mobile learning. This two-day format works exceptionally well, with delegates discussing key concepts, theories, themes and trends, while concomitantly developing their technological knowledge and TPACK skills. Following the inaugural and second conference in Galway in 2015 and subsequently in 2016, the third conference took place in Los Angeles in January 2017, while the 2018 conference returned to Galway. The 5th Annual MiTE Conference was hosted at the University of Technology Sydney (UTS), 18th-19th January 2019, reflecting the truly international MiTE profile and community.

Related to and dually supported by/supporting MiTE, there are two further key developments, which have contributed significantly in terms of external infrastructuring for mobile innovation in teacher education. These are the EU Project, Designing and Evaluating Innovative Mobile Pedagogies (DEIMP, 2017-2020), which emerged from the landmark EU Mobilising and Transforming Teacher Educators' Pedagogies (MTTEP) Project, and the International Mobile Learning Network for Teacher Educators (IMoLeNTE).

It is not possible within the constraints of a book chapter to discuss all aspects of the complex infrastructuring of mobile innovation, but these two key initiatives are especially notable in helping to support, expand and develop the potential of mobile learning technology, specifically in the context of teacher education.

DEIMP is an EU Erasmus+ Project coordinated by leading European researchers in the field, led by Prof. Kevin Burden, which will develop a MOOC, app, video scenarios and other salient resources, to support the expanding community of mobile teacher educators, and their capacity to embed innovative mobile technology within their practice and research, in order to augment key aspects of teacher education, including subject teaching methodologies.

Convened at the 4th Annual MiTE Conference in Galway in 2018, the IMoLeNTE network represents a first professional association for mobile teacher educators, supporting the growing community of practitioners and researchers to coordinate – on an international level – the advancement of mobile technologies within teacher education contexts.

Concluding reflections

Penuel (2019, p.10) notes that the ultimate goal of infrastructuring design is to render our research practices and outcomes more participatory, equitable and

impactful. Layered, multi-level design is imperative to try to promulgate truly transformational change in education – whether mediated by educational technology, or not:

Rather, infrastructuring efforts demand that we also re-design educational infrastructures that influence implementation to be more equitable (Penuel, 2015). When we “design across levels” in this way, we are engaged in a special kind of design research my colleagues and I call Design-Based Implementation Research (DBIR; Fishman, Penuel, Allen, Cheng, & Sabelli, 2013), so named because we are concerned with developing knowledge, tools, and practices related to equitable implementation of innovations and the capacity of partnerships to improve outcomes through inclusive research and development processes.

McKenney (2018) noted how issues of scale are increasingly important in our efforts to design for real, lasting and sustainable educational change. All parts of the MiTE infrastructure are not yet in place, nor is it entirely clear at this moment which further key elements need to be prioritised and developed; and indeed some elements are more advanced and coordinated than others, particularly at the local programme level. However, the ecosystem developed within and from the MGO programme stands as an exemplar for how we can start to achieve real change in how teachers engage with and deploy technology – particularly mobile technology – in their classrooms and teaching practices. As the programme and integration of mobile technology matures, it is increasingly evident that multi-level infrastructuring is crucial to sustaining and promoting the real achievements and changes that are so far realised. It is not sufficient to localise change just within the ITE programme; by supporting its propagation out into the research and practice communities, mutual benefits and enhancements can be achieved. Infrastructuring sustainably at multiple levels can be extremely time and resource-intensive. However, the MGO and MiTE represent an exemplar model of mobile learning in teacher education – research, practice and technology – and how these can be joined up to support and augment each other. By taking an ecosystem perspective between our local innovations (e.g. MGO) and key external developments (e.g. MiTE, IMoLeNTE, DEIMP, MTTEP) we can support mutual sustainment of key aspects of infrastructure – both internal and external. By widening the sphere of collaborative design – where we truly work and learn together shoulder-to-shoulder - with teachers and our colleagues in research, industry and policy – we can start to infrastructure effective innovation with mobile technology in teacher education, both within teacher education programmes and out into the schools and wider, professional educational community and society. As well as the now well-established and internationally renowned local innovation within the MGO programme, our experiences underscore the imperative to ‘network out’, into the research and technology communities, maintaining across all our work that crucial three-sided emphasis on the researcher, practitioner and technologist. This is especially important today, in an age where the teacher as researcher and evidence-informed practice are becoming more important, and mobile technology is truly creating significant

new potential for us to mediate and support enhanced learning, teaching and assessment, in teacher education, and beyond: in classrooms and schools.

References

- Apple Education. (2019). *Apple Distinguished Schools*. Retrieved on 19/01/2019 from: <https://www.apple.com/au/education/apple-distinguished-schools/>
- Barab, S., & Squire, K. (2004). Design-Based Research: Putting a Stake in the Ground, *The Journal of the Learning Sciences*, 13:1, 1-14, DOI: 10.1207/s15327809jls1301_1
- Baran, E. (2014). A Review of Research on Mobile Learning in Teacher Education. *Journal of Educational Technology & Society*. Vol. 17, No. 4, Review Articles in Educational Technology (October 2014), pp. 17-32 (16 pages).
- Department of Education and Skills. (2015). *Digital Strategy for Schools 2015-2020: Enhancing Teaching, Learning and Assessment*. Retrieved on 11/22/2018 from: <https://www.education.ie/en/Publications/Policy-Reports/Digital-Strategy-for-Schools-2015-2020.pdf>
- European Commission. (2018). *Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions on the Digital Education Action Plan*. Retrieved on 12/01/2018 from: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0022&from=EN>
- Kearney, M., Schuck, S., Burden, K., & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective, *Research in Learning Technology*, 20: 14406 - DOI: 10.3402/rlt.v20i0/14406
- Koehler, M.J., Mishra, P., Bouck, E.C., Deschryver, M., Kereluik, K., Seob Shin, T., & Graves Wolf, L. (2011). Deep-play: Developing TPACK for 21st century teachers, *International Journal of Learning Technology*, 6(2): 146-163, DOI: 10.1504/IJLT.2011.042646
- Koehler, M.J., & Mishra, P. (2009). What Is technological pedagogical content knowledge?, *Contemporary Issues in Technology and Teacher Education (CITE)*, 9(1), 60-70.
- Mac Mahon, B., Ó Grádaigh, S., & Ní Ghuidhir, S. (2018). From iTE to NQT: Evaluating Newly Qualified Teachers' Use of Mobile Technology in Their First Two Years of Teaching. In Hall, T. (Ed.). *International Journal of Mobile and Blended Learning*. Special Issue: Designing Mobile Teacher Education (pp. 8-19). DOI: 10.4018/IJMBL.2018040102
- McKenney, S., & Reeves, T. (2018). *Conducting Educational Design Research (2nd Edition)*. London & New York: Routledge.

McKenney, S. (2018). How Can the Learning Sciences (Better) Impact Policy and Practice?, *Journal of the Learning Sciences*, 27:1, 1-7, DOI:10.1080/10508406.2017.1404404

McKenney, S. (2011). *Designing and researching technology enhanced learning for the zone of proximal implementation*. Retrieved on 12/01/2018 from: <https://dspace.ou.nl/bitstream/1820/4030/1/ASLD-2011-ZoneProximallImplementation.pdf>

Melhuish, K., & Falloon, G. (2010). Looking to the future: M-learning with the iPad. *Computers in New Zealand Schools: Learning, Leading, Technology*, 22:3. Retrieved on 12/01/2018 from: <https://www.otago.ac.nz/cdelt/otago064509.pdf>

Penuel, W.R. (2015). "Infrastructuring as a Practice for Promoting Transformation and Equity in Design-Based Implementation Research," *Keynote presented at the 11th Annual International Conference of the International Society for Design and Development in Education (ISDDE)*, University of Colorado, Boulder, CO, September 22, 2015. Retrieved on 13/01/2019 from from: <http://learndbir.org/talks-and-papers/infrastructuring-as-a-practice-for-promoting-transformation-and-equity-in-design-based-implementation-research-2015>.

Penuel, W.R. (2019). Co-Design as Infrastructuring with Attention to Power: Building Collective Capacity for Equitable Teaching and Learning through Design-Based Implementation Research. To appear in: Pieters, J., Voogt, J., & Pareja Roblin, N. (Eds.) *Collaborative Curriculum Design: Sustainable Curriculum Innovation and Teacher Learning*. In press.

Puentedura, R.R. (2015). *SAMR: A Brief Introduction*. Retrieved on 12/01/2018 from: http://hippasus.com/rrpweblog/archives/2015/10/SAMR_ABriefIntro.pdf

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform, *Harvard Educational Review*, 57(1), 1-22.

US Department of Education (Office of Educational Technology). (2016). *Section 2: Teaching with Technology*. Retrieved on 12/01/2018 from: <https://tech.ed.gov/netp/teaching/>