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Educational narrative inquiry through design-based research: Designing digital storytelling to make alternative knowledge visible and actionable

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Abstract

This paper describes the conceptualisation and appropriation of narrative in the design of digital storytelling technology (DST), to augment reflective practice among Irish pre-service teachers. Reflective practice remains a predominant professional formation component of programmes of teacher education. In this key developmental activity, teacher education traditionally privileges written reflections, e.g. pro forma post-lesson evaluations and essays. Our aim in this research was to supplement, not supplant, these important written reflective modalities, and by doing so, open up a wider set of possibilities for using narrative and technology to support creative, potentially transformative reflection on practice. We have been inspired significantly in this DST work by Bruner's (2002) functional view of narrative inquiry - that storytelling serves as the principal, foundational means by which we form our identities, relate to others, and make sense of our place in the world. We thus sought to explore how innovative storytelling designs, combined with, and augmented by digital technology, might afford new narrative inquiry possibilities for pre-service students to conceptualise, create and collaborate in their early-career, reflective practices. This paper presents R-NEST, the educational design we developed in a principled and participatory fashion over 3 years, collaboratively with 323 student teachers. We trace the narrative of the development and refinement of the bespoke R-NEST design, illustrated with analysis of an exemplar, student-designed digital story. The paper concludes with insights regarding the creative, reflective use of DST, suggesting potentially wide scope for this mode of narrative technology in education.

Keywords: Reflection, functional narrative inquiry, design, technology-enhanced learning, initial teacher education

Introduction

Research has demonstrated the importance and potential of alternative, novel representations of teachers' reflections, including the use of information and communications technologies (ICTs) to mediate and support such innovative processes and projects (Cochran-Smith et al. 2015; Gore 2015). However, there is a gap in the literature regarding systematic design research demonstrating – in an applied manner – the impact of narrative technology, including digital storytelling, on learning and teaching.

At the outset of our research, there existed no models of best practice for using digital storytelling in initial teacher education. We sought therefore to redress this, and investigate critically – on a large scale and longitudinal basis – digital storytelling as a mediating narrative technology for our students to engage in augmented, multimodal reflection. As will be presented, while situated locally in the Irish context, by using design-based research (DBR), we hoped to produce an educational design model and resources which could be adopted and adapted to impact positively on teacher reflection in other jurisdictions and contexts. However, across all design-based research, there are inherent limitations constraining the scope to produce finished, all-purpose solutions to meet every eventuality, especially when seeking to transfer educational designs to other, diverse contexts, which have their own respective exigencies and requirements (Hoadley 2006). Our goal therefore was not to develop a neat, narrative reflective practice package *per se*, but rather a technology-enhanced learning toolkit and resources that can be adapted for different teacher education contexts, to help teachers to reflect in a situated and creative fashion on challenges, opportunities, problems and tensions emerging in their teaching practice. 'Narrative uncertainty' prevailed across all our work; therefore, we hoped to develop digital storytelling to help student teachers, at least to surface and recognise the elisions and tensions in their narrative inquiry into

practice. Furthermore, by engaging them in designing digital stories, we hoped to provide a computer-supported means for them to mediate and work constructively through the crucial affective dimensions of reflective practice (Corcoran and Tormey 2012).

Defining and designing digital storytelling

Digital storytelling is a set of multimodal digital tools – typically based on digital video applications and software – that can be used to enhance pre-service teachers' reflection on practice (Barrett 2005). DST can take them beyond the print-centric written reflection that predominates in initial teacher education (Kajder and Parkes 2012). Digital video editing and post-production are now widely available and becoming increasingly easy-to-use, including on mobile platforms, e.g. smartphones, and ultra-portable devices, e.g. iPad.

Providing students with an alternative means of reflecting on practice, which includes the use of multimedia elements in addition to written reflection, has the potential to lead to deeper engagement in the process of reflection, and thereby result in more profound, potentially transformational representations of reflection (Cochran-Smith et al. 2015; Gore 2015). Digital storytelling is being used in education to enhance reflection (Barrett 2006), develop literacy (Banaszewski 2005) and promote 21st Century skills (Jakes 2007). It has been suggested that creating a digital story can enhance teachers' reflection on practice (Kearney 2009), improve their technology skills, and increase their technology self-efficacy (Heo 2009).

There are several different genres or types of digital storytelling. In our research however, we followed the DST model developed originally at the Center for Digital Storytelling, Berkeley (Lambert 2009). This DST approach involves the production – by someone who is not a media professional – of a short, 3-5-minute video, normally

constructed as a thought piece on a personal experience (Matthews-DeNatale 2008). The creation of the digital story includes incorporating multimedia components such as still images, music, video and a narration, which is usually the author's own voice (Dogan and Robin 2008). While the digital story is created using ICTs, the emphasis is on the narrative design and creation, with the story itself the most important element in the digital storytelling process (Lambert 2009; Matthews-DeNatale 2008). Further, the rationale for selection of multimedia is their efficacy and impact in amplifying the narrative construction and communication of the story.

We will first outline the main theoretical orientation in our work on using DST as a technology-enhanced narrative inquiry process with our students, and the piloting and iteration of our design, which we called R-NEST. As well as suggestive of a shared nest and fledgling reflective practice, (perhaps apt metaphors for pre-service teaching), R-NEST stands for reflection, narrative, engagement, sociality and technology: the five salient features of our digital storytelling design-based research model. Subsequently and importantly, we will discuss an exemplar digital story, students' experience and feedback on the process, in illustrating the design and implementation of the R-NEST model for digital storytelling within initial teacher education.

Situating narrative in design-based research: The initial R-NEST design model

Our guiding philosophy of narrative was predicated on key research and writing in the field, inspired principally by Bruner's functional view of narrative inquiry, and his narrative-based theory of the mind, human development and education. According to Bruner, life itself is autobiographical – we are each the protagonist, the main character in our own, ontogenetic narrative. Furthermore, narrative helps our culture and society to cohere, persist and grow; stories provide an 'Enormous amount of

unification within a society'; 'There is no culture in the world without stories' (Bruner 2007).

For Schank (1990, 16) narrative is synonymous with intelligence. He argued that, 'All we have are experiences – but all we can effectively tell others are stories. Knowledge is experiences and stories, and intelligence is the apt use of experience and the creation and telling of stories'. Both Bruner and Schank underscored the pre-eminence of narrative and storytelling in education, pointing to the importance of critical and reflective narrative inquiry, to deeply and verily understand identity, community and wider society.

Bruner posited that the influence of narrative extends throughout our lives, bestowing meaning and structure on what we experience: 'it is our preferred, perhaps even our obligatory medium for expressing human aspirations and their vicissitudes, our own and those of others. Our stories also impose a structure, a compelling reality on what we experience, even a philosophical stance [how we position our own worldview in respect of others']' (2002, 89). For Bruner (2002) narrative and story are synonymous, furthermore providing us with three fundamental narrative principles for education (2007):

- *Multiplicity*: there are many possible ways of knowing;
- *Perspectival*: our interpretation of anything is shaped by our worldview, which challenges the verifiability of human understanding;
- *Comparative*: the scope of our understanding is affected by the existence of alternative ways of knowing or seeing the world.

We hoped that engaging in DST design and development would support our students – in their emergent reflective practice – to move towards attaining Bruner's

three principles: (1) that they would be able to visualise and engage with many possible ways of knowing; (2) come to understand their own *weltanschauung* (worldview) better; and (3) draw on alternative ways of knowing or seeing teaching and learning, particularly with respect to insights from their educational lectures and teacher education programme.

Derived from and shaped significantly by Bruner's ontology of narrative, we developed the R-NEST framework to guide our design work. Such a systematic approach is typical in design-based research where the design process starts with an initial framework, which normatively emerges through a synthesis of four principal activities: (1) the biographical interests and motivation of the researchers; (2) the identified research gaps and questions; (3) theorisation drawing on key concepts and principles; and (4) review of extant, relevant literature in the field (Hall et al. 2017).

In design-based research (DBR), educational problems are characterised as inherently complex, involving not just a limited set of concerns and related interactions, as in experimental research, but myriad different actors and factors, or *multiple dependent variables* (Barab and Squire 2004). Cited in Reeves (2015), Phillips described the complexity of educational design thus:

> Learning is a phenomenon that involves real people who live in real, complex social contexts from which they cannot be abstracted in any meaningful way. Difficult as it is for researchers to deal with, learners are contextualized. They do have a gender, a sexual orientation, a socioeconomic status, an ethnicity, a home culture; they have interests—and things that bore them; they have or have not consumed breakfast; and they live in neighbourhoods with or without frequent gun violence or earthquakes, they are attracted by (or clash with) the personality of their teacher, and so on. (616)

In order to apprehend educational problems and questions in a sufficiently cogent and comprehensive manner, DBR relies on what Barab and Squire (2004) called

multi-ontological frameworks, a theoretical plurality where several relevant theories, or elements from them, can be drawn together to address effectively the multiple dependent variables that are typically involved in complex educational design. Therefore, in addition to Bruner, R-NEST was derived from consideration of a broad literature relating to the five key components of the model: reflection, narrative, engagement, sociality and technology.

Considering that enhancing reflection was the central focus of the research, our theorisation of same was underpinned by a very extensive review and synthesis of key researchers and theorists, including the seminal early thinking about reflection, principally Dewey (1910, 1916, 1933); the critical work of Lortie (1975), Schön (1983, 1987), Moon (1999), and Korthagen and Wubbels (2001b, 2001a); and research on the use of storytelling and multimodal, digital methods to support teachers' reflective writing, for example, Moon (2004), Lambert (2009), and Kajder and Parkes (2012). In addition to reflection, the R-NEST design model emerged through engagement with key literature related to the other four major themes, including, among others, Bruner (2002) for narrative (as a primary means of our identity development, sense-making and understanding), as exampled; Csikszentmihalyi (1991) for engagement (particularly the notion of *flow*, where we are deeply committed to seeing something through, even when it is challenging or difficult); McDrury and Alterio (2002) for collaborative storytelling in higher education (the importance of shared storytelling in learning); and Norman (1998) and Gilbert (2002) for technology usability (digital media need to be easy-to-use; if arcane or problematic to use, teachers are less likely to engage with technology, at least on any kind of sustained basis).

The guiding principles of R-NEST informed our study throughout. Furthermore, they also provided us an evaluation framework, which we could use to assess the impact

of the educational design across the five key themes of reflection, narrative, engagement, sociality and technology. The initial R-NEST principles were:

- the potentially important role of storytelling as a medium for identity development in teacher education;
- the central importance of collaborative learning among pre-service teachers, especially in relation to personal stories of change (Lambert 2013) and reflection thereon;
- easy-to-use technology and easy-to-access and use, rich media content; and
- creative engagement in the process.

A number of assessment instruments were deployed to evaluate students' completed digital stories. The evaluation of the DST innovation evolved concurrently with the design over the 3 years, and included artefacts such as students' completed digital stories, their working portfolios, online discussion boards, a post-DST questionnaire, and qualitative feedback. The data derived from these evaluations were the subject of critical analysis, undergirded by the R-NEST design principles. The R-NEST model is now in its eighth year of deployment, and thus a mature, key part of the wider reflective practices within the local teacher education programme.

In our paper, given the theme of this special issue, we focus in particular on the narrative aspects of the R-NEST design, and indeed on the narrative arc of our own learning, especially in the key point of inflection in the R-NEST design process, which is when we scaled up: from the first-year pilot to the mainstream deployment of digital storytelling in the second year. Moving from pilot (n=18) to mainstream (n=208) marked the point where we garnered the most salient learning regarding how best to design the narrative technology for deeper reflection. The third cycle of design and

evaluation was of course important but it served more to corroborate overall the R-NEST process, and especially the design work done across the pilot and first mainstreaming of the DST innovation.

Further, as suggested by the title of our paper, we also wanted to move – if we could - toward making *actionable* alternative knowledge, and beyond mere novel visualisations of reflection as digital stories. We were seeking to tap into and exploit the transformative potential of digital storytelling (Jamissen et al. 2017), where our student teachers' engagement in the R-NEST design process might augment their emergent identity as educators, and therewith their teaching philosophies and practices.

Pre-service teachers from across almost all subject domains of the Irish secondary school system engaged in the research, ranging from the sciences and mathematics to languages and humanities disciplines.

The DST Pilot Study

We rolled out the pilot project on a voluntary basis with a 'start small' cohort of 18 students in February and March, 2010. For the initial intervention, students were given the opportunity to create a digital story instead of an essay for the closing section of their professional practice portfolios. All students on the course (n=221) received five 1- hour lessons on the different components of digital storytelling, and the pre-service teachers who chose to create a digital story were asked to incorporate the following in their digital stories:

- reflect on your educational journey to this point and your decision to become a teacher;
- re-evaluate learning goals and learning philosophies articulated at the start of your teacher education, evaluate achievement of these learning goals;

- trace any transformations in your learning and teaching beliefs, values, attitudes, and assumptions, how these changes have come about;

- relate what/why/how different elements of the teacher education programme contributed to your learning and teaching;

- highlight significant landmark achievements/improvements you have made to your learning and teaching (please draw from your journal, lesson plans [lesson designs for teaching practice] and evaluations [reflections on teaching, both individual and collaborative – with their mentor/tutor].

This initial design aligned well with the broad topics used for DST with pre-service teachers in the literature at the time (Heo 2009; Kearney 2009). We hoped the questions/tasks above, particularly student teachers' creation of DSTs based on them, would prompt the pre-service teachers to come to a deeper understanding of their initial school placement experience, as a basis for revealing to them alternative knowledge, which could be useful to action positive changes in their teaching practice and emergent professional teacher identity. As we will now illustrate the results of our initial pilot intervention proved surprising, and provided us with crucial learning, which we were able to use to improve significantly our R-NEST design model.

During the pilot project, a specific, bespoke assessment rubric was developed to evaluate systematically students' digital stories and the depth of reflection evidenced by them. The rubric was based on other DST rubrics reviewed in the literature, specifically schemes created by Barrett (Barrett 2005) and the personal expression analytical student scoring guide (Porter 2004), the Western Massachusetts Writing Project (Hodgson 2010), and the guidelines from *Integrating digital storytelling into your classroom* website (2006).

Findings and reflections from the pilot DST intervention

A total of 18 students created digital stories for our initial pilot study of digital storytelling design as a narrative enquiry process for making both visible and actionable alternative knowledge. Items used for data analysis included the students' completed digital stories, their 'working portfolios', the online discussion board, student emails and a post digital storytelling questionnaire created to elicit student feedback on the process of designing a digital story. Of the 18 students who completed a DST, 16 students granted permission to use their digital stories for research, and 12 students took the post-DST questionnaire.

When the original assessment rubric was used to analyse the students' digital stories, we realised that it was too heavily based on the technical aspects of creating a digital story. Out of 7 criteria, only three criteria dealt with the actual content of the digital stories, and only one of these criteria dealt with depth of reflection. In order to assess the DSTs for depth of reflection, an additional rubric was created, based on Moon's (2004) Generic Framework for Reflective Writing. This was then used to analyse the DSTs for depth of reflection. The results are shown in Figure 1.
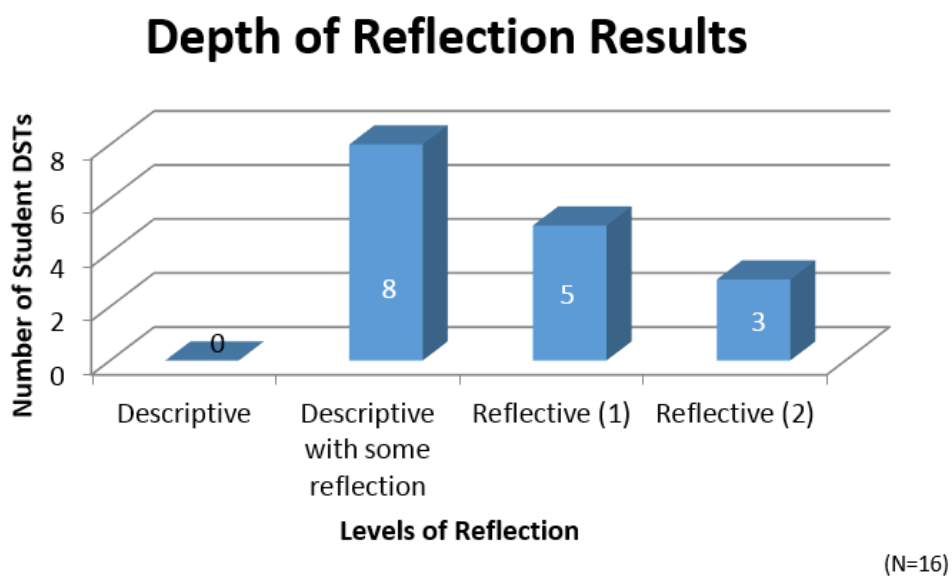

Depth of Reflection Results

(N=16)

Figure 1 Pilot Depth of Reflection Scores.

Using this rubric, we were surprised to discover that the student with the highest score for depth of reflection in their digital story had completely disregarded the assignment brief. His multimedia narrative dealt with his own rebellion from a family of a long line of teachers, only giving in to the calling he felt to teach later in his life. He delved into his own developing teacher identity, and his use of many metaphorical images was deeply reflective as well. Especially effective was his use of images of shadows to represent the family teaching tradition that had haunted him in his younger life.

In assessing this and the other students' DSTs with the depth of reflection rubric, we came to the realisation that the task we had set for students – a reflection on their year as student teachers – was much too broad a topic for their digital stories. If we were to allow them to delve into their teaching practice and provide the depth of reflection we were hoping to mediate with the digital storytelling design, we would need to change the focus and topic of the digital story assignment.

Key design changes in the 2nd iteration of the DST intervention

Consequently, two major and related design changes were made for the second iteration of the DST project. The first was a complete redesign of the assignment topic. Students needed a task that would allow them to delve deeply into an experience and explore their own motivations, feelings and emotions, as identified by Moon (2004). The second was a redesign of the assessment rubric to include more comprehensive criteria in relation to reflection. In addition, we felt students needed more guidance on narrative and story structure, so this was also expanded on in the digital storytelling lessons.

A return to the reflective literature highlighted Moon's (1999) encouragement of the use of creative methods for reflective learning. She stated that the use of creative

techniques can '…generate different forms of reflection and may bypass the resistances that can block normal reflective processes or else introduce new perspectives for reflection' (204). Two of her suggestions for these creative types of reflection are reflection on a critical incident, and the use of story, both of which involve focused, structured thinking about learning in the placement situation (Moon 1999).

One of the sections of the students' existing professional practice portfolio was an essay on a critical incident (Tripp 1993) from their teaching practice experiences. The brief defined the critical incident as '…a happening, a specific incident or event either observed by you or involving you. The happening sparks your thinking and makes you subsequently think and/or act differently about the particular event and related issues' (School of Education NUI Galway 2010). We realised that the critical incident assignment could provide the focus that our digital story assignment needed. Students would be able to pick one incident from their teaching practice and delve deeply into it. This focus on one particular incident also lent itself more to the intrinsic narrative aspects of a digital story.

The assignment brief was re-designed, incorporating the criteria from the critical incident assignment. The assessment rubric was also redesigned. This was based on the critical incident criteria as well as the Center for Digital Storytelling's Seven elements of effective digital stories (Lambert 2007, 2010). Criteria thus included:

Content (Critical incident)

- Rationale for choice of critical incident and context

- Outline of incident

- Demonstrates learning that involves the whole person

- Draws on other perspectives and time frames

- Demonstrates change in thoughts or actions

- Evidence of integration of theory and practice

Planning

- Working Portfolio

- Storyboard

- Reflective write-up

Mechanics

- Citation of Sources and Permission

- Length of DST

Story Structure

- Dramatic question

- Personal narrative

- Economy of story

- Resolution of dramatic question

Use of Technology

- Images complement and help convey the ideas in the script

- Soundtrack (optional) contributes to the message of the story

- Voiceover supports purpose and tone of story

- Student utilises video editing software effectively

The critical incident criteria were weighted more heavily than the rest of the criteria, carrying 10 marks each as compared to 5 for the other criteria in the rubric, to emphasise for students the importance of the reflective elements of the digital story. Moon (2004) furthermore suggested the use of critical incidents as a form of second order reflection that can help to telescope and focus reflection. She defined second order reflection as any reflective activity that requires a learner to look through previously written reflective work and to '…write a deeper reflective overview' (148). This 'reprocessed' material is more valuable as students are afforded the chance to reflect on their primary reflections, which can lead to deeper levels of reflection and improved learning (Moon 2004). The DST assignment brief asked students to choose an incident that they initially wrote about in their reflective portfolio while out on teaching practice and to delve into this in a deeper manner.

Moon (2004) states that one of the easiest ways to get learners started on a reflective writing activity is to use a series of questions that can lead them into it. The revised DST brief guided students to tell their story as a personal narrative which explained their critical incident and answered the following questions for the reader-viewer:

- What is your rationale for choosing this incident?
- What happened during the incident? Who was involved?
- What were your initial beliefs about the incident?
- What is the possible significance of the incident in context of the school and the wider society?
- What issues were raised for you by the incident?
- How did you deal with these issues?
- How did the incident impact on your emotions, thoughts, beliefs and actions?

- How has this incident changed your thoughts and/or actions?

- What did you *learn* from this incident?

- What resources did you utilise to help you reflect on and resolve this incident? E.g. relevant literature, colleagues, your own internal dialogue, drawing on thoughts about the event within different time frames, etc.

Changes were also made to the DST lessons to enhance students' understanding of story structure and the collaborative sharing of their stories at a draft stage in the process. During the first 'introduction to digital storytelling' lesson, students were introduced to the foundational 'Hero's Journey' narrative (Campbell, 1973, cited in Ohler, 2008) through the use of Ohler's (2008) 'Visual Portrait of a Story', a story map he created based on Dillingham's (2001, cited in Ohler 2008) model of the story map. He suggested that this story map, if used with students, will be '…the tool they will use to do their most important work in terms of articulating the essential elements of their stories' (Ohler 2008, 79). Ohler states that using story maps to help students flesh out their stories can '…ensure that the sequence of events supports a story that is compelling and memorable' (2008, 78). The story map helpfully provides a visual portrait of the traditional narrative arc of beginning, middle and end – similar to the three-part structure that is widely used in filmic storytelling– beginning/problem; middle/transformation; and end/resolution, or denouement.

Ohler's (2008) story map was introduced to students during the pilot project, but only fleetingly, as a narrative tool they might want to use to help them develop their story. During this second iteration, it was used as a main, integral narrative part of the introductory lesson on digital storytelling, and mapped specifically to the telling of a critical incident story. Students were required to submit their completed story map as a

part of their 'working portfolio' (all their DST planning materials) with their finished digital story.

Finally, the 'story circle' (Lambert 2009) step of the digital storytelling process, where students share their draft stories in small groups, was enhanced. McDrury and Alterio (2002) emphasised the importance of providing students with opportunities to share their practice stories as this '…encourages a reflective process, especially when storytelling is accompanied by dialogue and occurs in formalised settings' (111). They recommended a formal, structured narrative sharing session, where tellers share a pre-determined story and listeners engage tellers in reflective dialogue, in contrast to informal story sharing situations where significant learning may be more limited. We felt that a structured 'story circle' activity would benefit the students greatly in the narrative processes of sharing and creating their digital stories. This was designed and implemented with students during the second iteration of the DST design.

Findings from evaluation of the mainstream iteration

A total of 208 students created digital stories for the second iteration of digital storytelling design as a mediating narrative process for making alternative knowledge both visible and actionable. Of these students, 133 gave permission for their materials to be used in the data analysis. As in the pilot project, items used for data analysis included the students' completed digital stories, their 'working portfolios', the online discussion board and a post digital storytelling questionnaire, created to elicit student feedback on the process of designing a digital story. In addition, for the second design iteration, students were asked to complete an 800 to 1000-word reflective feedback essay on what they thought of the DST process and the product they created. Forty-nine students completed the post-DST questionnaire, which asked them to report on their experiences

of creating a digital story – what they liked/disliked - and whether they felt it was of benefit to them as a reflective process.

We found the revised assessment rubric a much better instrument for measuring the depth of reflection in student teachers' digital storytelling projects; as indicators for depth of reflection, suggested by Moon (2004), were now incorporated in the critical incident criteria. Several different parts of the DST rubric were used to devise a depth of reflection score for the students for the second design. These included the critical incident criteria, the reflective feedback essay, and the use of multimedia in a reflective manner. These scores were tallied and a 'reflective score' was given. Based on the marking scheme used by the university, a rating of high (70-100%), medium (50-69%) or low (0-49%) levels of reflection were assigned. The reflective scores are represented in Figure 2.
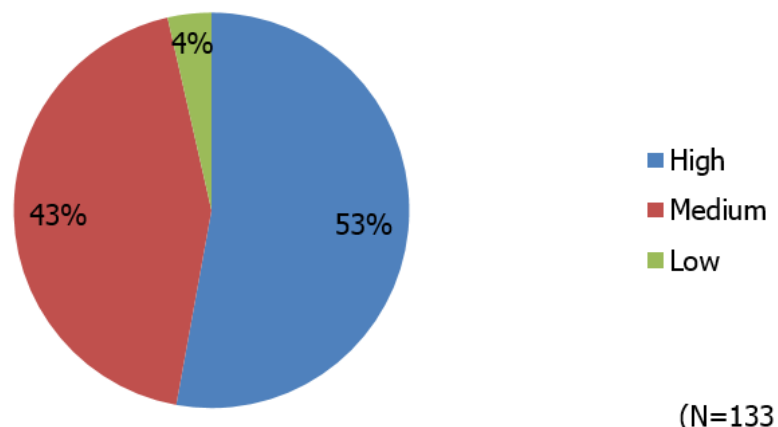
2010-2011 Level of Reflection Scores

(N=133

Figure 2 2010-2011 Student levels of reflection achieved.

The vast majority of students' DSTs showed medium to high levels of depth of reflection, with 53% showing high levels of reflection. This is a marked improvement

on the depth of reflection evidenced in the pilot project DSTs, where only 3 of the 16 students' digital stories (19%) showed high levels of reflection. In terms of guiding the assessors' grades, we foregrounded particularly the importance of reflection as a call to action. We wanted our students to show compellingly how the formative experience and reflection on it had helped to confirm or disconfirm a non-trivial aspect of their existing and future beliefs about teaching, and their teaching practice, 'Clearly conveys how critical incident has changed their thoughts and/or actions'. We also wanted to see in students' DSTs explicit integration with relevant concepts and theories of education, where they would directly cite relevant lectures and literature from their teacher education programme, 'Incorporates at least three quotations from academic literature about teaching and learning that hold significant meaning for them in relation to critical incident'. Students were also awarded marks for their creative and innovative engagement with the crucial narrative design aspects of the DST process, and where their story demonstrated impactful intonation, visuals and effects, 'Implicit imagery used to convey information that is not contained in the script but that adds to storyline and sense of satisfaction with the story. Tone of the visuals is aligned with tone of the story or is juxtaposed to the story with specific intent/Exceptional use of movie editing software. Titles, transitions and effects used effectively and greatly enhance the experience of watching the digital story.' The comprehensive rubric for assessing students' DST extended to four-pages of detailed, gradated criteria in respect of reflective narrative design (Thompson Long and Hall 2015).

The majority of students who completed the post DST questionnaire felt that the digital storytelling project enhanced their reflection, as shown in Figure 3.

Creating a DST is a Reflective Process

(N=55)
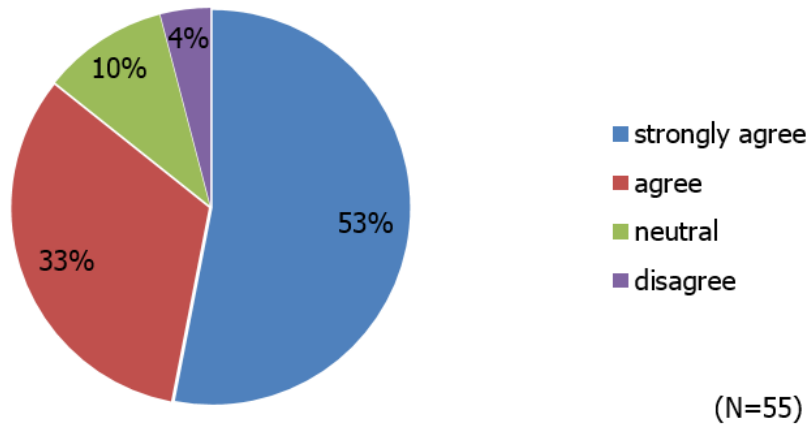
Figure 3 Student questionnaire responses to the statement, 'Creating a DST is a reflective process'.

When asked if they felt that creating a DST is a reflective process, 86% felt that it was, with only a small portion feeling that it was not.

Students also wrote positively about their DST experience in their reflective feedback essays. Many described DST as a different and engaging way of reflecting, and most enjoyed this different form of reflection, which enabled them to utilise multimedia and really delve into the topic at hand. Some examples of this from the students' reflections include:

> I had already reflected on the bullying 'critical incident' in my reflective journal and 3rd weekly reflection, but making the DS made me look at it from a whole other angle. I had to look much deeper at the feelings behind my reactions and made the connections to my own past experiences with bullying. (2010-2011 Student 10)
> As the PGDE emphasizes the importance of student teachers engaging in critical reflection throughout their training and in their subsequent careers, digital

storytelling offers an opportunity to do just this but in a new and innovative way. (2010-2011 Student 109)

The process encouraged me to delve deeper into the incident and into myself. As I listened to my own voice and observed the type of images I was drawn to, I began to learn more about my perception of the world and how, really when we see, we see it through our own cultural blindfolds. It seemed the more I reflected on the incident, added pictures, heard the story repeated over and over, the more it taught me. (2010-2011 Student 126)

Overall, many students noted in their feedback essays that the DST enabled them to reflect more deeply than they had done in other reflective assignments on the course. The reasons they gave for this additional depth to their reflection, many of which can be found in Moon's (2004) description of the processes of deeper reflection, were:

- 'Taking more time to reflect on the incident

- The self-questioning required during the process

- Reflecting on the incident as a whole; stepping back, seeing the bigger picture

- Looking at the incident from different time frames and from different perspectives

- Learning from listening to their own story over and over again

- Creating multiple story drafts

- Bringing up hidden themes, issues

- Assessing personal beliefs

- Connecting theory to practice

- Causing a deeper assessment of their own actions' (Thompson Long 2014, 231)

The digital stories resulting from the second design iteration were really *stories*. The majority of students were very successful in taking a primary reflection from their

reflective journal and using it to create a story about what they learned from their critical incident. This can be seen in Figure 4, which shows the 'narrative' scores derived from the students' story structure marks from the rubric.

2010-2011 Narrative Scores

4%

33%

63%

■ High
■ Medium
■ Low

(N=133)
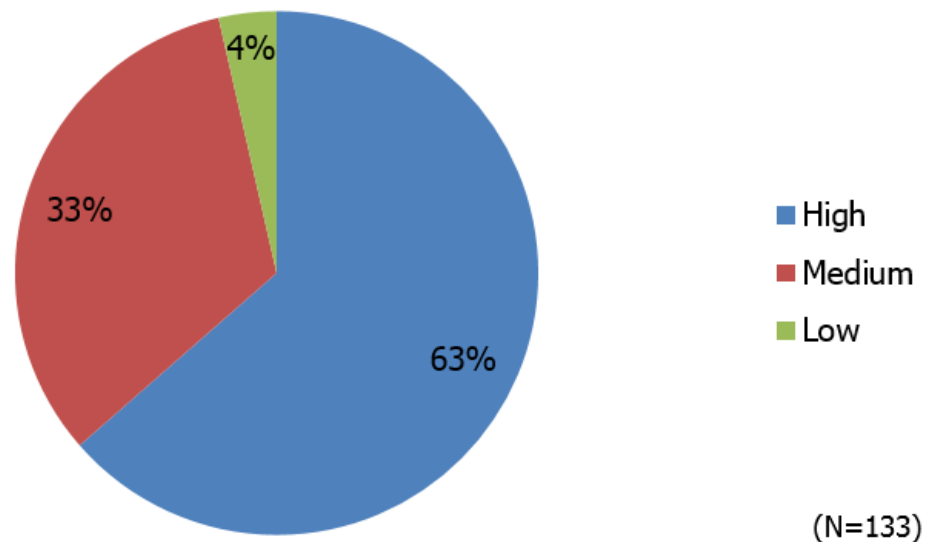
Figure 4 2010-2011 Narrative scores from the DST rubric.

More than two-thirds of the students met the narrative criteria at the highest level, while over one-third scored in the medium level. The extra instruction on story format at the beginning of the process, the use of the critical incident as the basis of the story, and the structured 'story circle' activity to enhance students' collaborative reflection and storytelling, contributed successfully to the high number of students utilising personal narrative to tell the story of their critical incident.

Exemplar digital story – analysed for narrative and reflective impact

One digital story that we have used as an exemplar with students in all subsequent years of the DST project was created by a student in the second year of the project. He did an excellent job of meeting the assignment criteria in all areas: depth of

reflection; evidencing learning from his critical incident; the use of personal narrative; the use of images to relay meaning, using music and sound effects to contribute to the story; as well as utilising the video editing software effectively to enhance the story. He also linked key moments in his reflective narrative back to relevant educational literature, theories and thinking, which helped to anchor and deepen his critical reflection on bullying in school. Figures 5 and 6 detail a storyboard of his DST script, titled: 'When did bullying become just another word?', annotated to show how his DST met the criteria of the DST assignment. Due to copyright limitations on reproducing the images used, which were sourced from Getty images, a description of the images is provided instead.

Transcript	Image/Text on screen	Music	Relation to Criteria/Rubric
When did bullying become just another word?	Word cloud, starts with 1 word, Bullying, builds up to include lots of words about teaching practice.	Plaintive, sad piano music	**Dramatic question:** story structure
I'm 25 now, but it wasn't so long ago	Trophy with '25' on it.		**Demonstrates learning that involves the whole person:** Links to his own life, experiences as a student.
that bullying was a very real part of my life.	Sad, isolated, young teen in foreground, group of three other students in a group in the background.		
When I began the PGDE, and had psychology lecturers on bullying,	Smiling teacher at the front of a class.		**Rationale for choosing incident:** Touched on his own experiences, shows how bullying affected him personally, emotionally.
I thought to myself, "I know all about this stuff." And didn't I? Hadn't I been through it?	Close-up of young teen boy, head in hand, near tears.		
But that's the problem. I've been through it, and now it was just a distant memory, that time had dulled.	(Old film effect applied to above image.)		
When I began teaching practice in November, my favourite class was the first year 1X class,	Different image of a smiling teacher in front of a class.	Upbeat marching music, that fades to silence	**Outline of incident:** Clearly describes key features of incident, chronology of events are clearly understandable.
who were so full of beans and eager to learn.	Smiling kids in class with hands raised.		
They'd bombard me with questions and stories before I even made it in the door. Everything was going great, until the third week.	Different image of Smiling kids in class, all hands enthusiastically raised.		
I walked into 1X and immediately knew that something was wrong.	Students in class writing, all eyes down on paper. Two large clouds fade in over the class. Image colour changes from normal to greyscale.		
You could hear a pin drop.			
I was about to ask 'What's up?", when I noticed a couple of students glancing back at a boy called Philip, who was sitting at the back of the class.	Teenage girl looking across a classroom, unsure look on her face.	Brooding piano music	**Outline of incident:** Clearly describes key features of incident, chronology of events are clearly understandable.
He was leaning over his desk, with his head down, and face hidden from view.	Male student, head down on his desk, teacher blurred in background, at front of class.		
Then he looked up, and I saw his eyes were red with tears.	Small boy, tears running down his face.		
This really threw me.	Text on screen: What should I do? What's wrong with him?	Music, guitar, dissonant, fast beat	Shows how incident impacted on his thoughts.
Seeing this kid so upset, my mind just started racing	Text on screen: Does he need help? Should I stop class? Why is he crying? (Text flying on screen then off again, fast.)		**Different timeframes:** Shows how he felt immediately during the incident
My first instinct was to try and comfort him, find out what was wrong.	Teacher comforting student in front of school bus.		**Evidence of integration of theory and practice:** Linking to what he has learned in lectures.
But the voice of [lecturer's name] popped into my head, and I managed to stop myself.	Text on screen: Dr [lecturer's name], T&L lectures		
I remembered her words from a Teaching and Learning Lecture, and decided to wait and deal with it after class.	Text on screen: "Drawing attention to a problem can sometimes make it worse"		
After class, I asked Philip would he give me a hand carrying stuff over to the science lab, to give me a chance to chat with him.	Adult and child carrying large boxes down a hall, faces obscured by boxes.	Sad, plaintive piano music	**Outline of incident:** Clearly describes key features of incident, chronology of events are clearly understandable.
As we walked, I let him know I could see something was wrong, and if he wanted to talk, I was there.	Signpost with the word 'listen' on it accompanied by an image of an ear and sound waves.		
Thankfully he opened up to me and told me that boys in another class were bullying him; calling him names, and they had even written something on his desk.	Two boys picking on a third boy in between them, one about to slap him.		
As I listened to this story, my heart was breaking.	Glass heart breaking. ('Shatter' transition to next slide.)	Same sad piano music used with this image at beginning	**Demonstrates learning that involves the whole person:** Shows how incident impacted his thoughts and emotions.
Memories and emotions came rushing back, and it was like I was 14 all over again.	Same '14 year old boy' image from the beginning of the story.		
Somehow, I thought I'd never have to deal with bullying again,	Text on screen: Adair et al (2000) suggest that…		**Evidence of integration of theory and practice:** Text on screen is linking to theory/literature.
but considering most research shows bullying happens right under the nose of teachers, I should have been more prepared.	Text on screen – in red: Bullying… most often occurs in close proximity of teachers!!		

Figure 5 Example DST Storyboard and Analysis, Part 1.

Transcript	Image/Text on screen	Music	Relation to Criteria/Rubric
I did my best to cheer him up, and managed to get a smile out of him, before letting him go back to class.	Two balloons, large yellow one with happy face, smaller blue one with sad face.	Happy guitar music	**Outline of incident**
I spent the rest of the day in a daze. I wanted to help him, but how could I do that, without betraying his trust?	Young man, head in hand, thinking.		**Demonstrates learning that involves the whole person:** Shows how incident impacted his thoughts and emotions
That night, I rang my cooperating teacher,	Young man on mobile phone.		**Draws on other perspectives and time frames:** After incident, looked for cooperating teacher's perspective on the incident.
and he gave me some really good advice, and recommended I chat to the vice principal about it.	Text on screen: When kids are involved, always err on the side of caution.		
The next day, I did just that. It was intimidating going into her office,	Intimidating, unsmiling business woman behind large desk.	Scary music, drums, intimidating	**Demonstrates learning that involves the whole person:** Shows how incident impacted his thoughts and emotions.
and I began to doubt…	Text on screen: Should I be here? Is this a mistake? Did I overreact? (Text flying on, then off screen, fast._		
I expressed these feelings to her, as I told her the story, and she said something that I will never, never forget:	Text on screen: "If it's a big enough deal to Philip then it IS a big deal, and should be a big deal to us." (Text slowly rolling across screen in multiple layers.)	Happy guitar music	**Draws on other perspectives and time frames:** After incident, looked for VP's perspective on the incident, help with dealing with it.
Two days later, things were back to normal in 1X, like nothing had ever happened.	Wild class, laughing, standing on desks, throwing paper.		**Draws on other perspectives and time frames:** Different time frame, after the incident. **Story structure:** story arc
I heard that the vice principal had talked to Philip, and his bullies, and the other teachers had been told to look out for him.	Three adults, smiling, peering through a window.		**Outline of incident**
Later that week I bumped into the principal, and he stopped me. He told me he had heard how I had handled things, and he thought I was doing a great job.	Older business man with hand on shoulder of smiling younger man.		**Demonstrates learning that involves the whole person:** shows how incident impacted his thoughts and emotions
I was on cloud nine, as you can imagine.	Young business man jumping for joy, fluffy white clouds in the sky in background.		
But the whole experience really made me do a double take.	Cartoon man, hand on chin, looking uneasy.	Sad, plaintive piano music	**Draws on other perspectives and time frames:** Different time frame, after the incident.
I realised bullying cannot just be another word.	Whole word cloud from the beginning of the video, whittles down to just 'Bullying', then 'Bullying' gets bigger and bigger.		**Resolution of the dramatic question.**
It's easy to get caught up in the teaching part of being a teacher,	Hand hovering protectively over a sprouting plant.		**Demonstrates change in thoughts or actions:** His thoughts have changed on how to handle bullying and how important it is to be aware of it in the classroom. Thinking about the role of a teacher, his own teacher identity.
and lose sight of the other responsibilities that come with the job.	Two hands protecting a lit candle.		
There's a reason that the first line of the code of professional conduct for teachers	Text on screen: Code of professional conduct for teachers…		**Evidence of integration of theory and practice:** Linking to professional code of conduct. Also shows how his understanding of the teacher's role has changed because of this incident
mentions the need to care for the safety and welfare of our students. It's not just the teacher's job to educate these kids.	Text on screen: "1. Teachers should take care of students under their supervision with the aim of ensuring their safety and welfare insofar as reasonably practicable."		
We're also there to look out for them,	Text on screen: Look out		
to protect them,	Text on screen: Protect		
to care for them	Text on screen: Care		
Bullying is one of the biggest dangers these kids will face that can affect them for the rest of their lives.	Man comforting teen girl, protective arm around her, other hand outstretched with the words 'just stop' written on it.		**Demonstrates change in thoughts or actions:** Ultimately his thoughts on bullying have changed, as well as how he will handle any bullying incidents as a teacher in the future.
Something I'll never let myself forget, no matter how much I'd like to.	Sad 14 year old boy image from the beginning again. ('Old film' effect on image, fading to clear image.)	Same sad music from beginning	

Figure 6 Example DST Storyboard and Analysis, Part 2.

Conclusions and discussion: insights from the DST design

The three implementations of the R-NEST DST design demonstrated the significant potential, and formative and positive impact of digital storytelling as a narrative technology within initial teacher education.

R-NEST supported the authors, as teacher educators and educational designers and technologists, to develop educational technology – in a principled and participatory fashion – to enhance our pre-service teachers' capacity to reflect critically on their professional development and practice learning. We observed how the majority of students that participated in our interventional design study evidenced greater engagement in reflection through the completion of digital stories.

Contrariwise, across the three iterations, there were some students who disliked the DST innovation, or who felt it was a waste of time; this was consistently a very small proportion in each design cycle. This negative feedback seemed correlated with 'innovation-aversion', or general disengagement within the teacher education programme, and warrants further research, to explore why pre-service teachers do not engage with educational technology, in particular digital storytelling. In any case, it may just not be possible to achieve 100% satisfaction with any educational design or innovation; although this is always what we must aspire to.

In contrast, the preponderance of students reported very positively on the R-NEST process and DST design. The impact of narrative, combined innovatively with digital multimedia, to enhance student teachers' reflection on practice is an important contribution of this design-based research. Overall, students benefitted significantly from the design of digital storytelling, in making better sense of the experience of their first foray into teaching, and in gaining a deeper understanding of the processes one needs to go through when reflecting critically on practice. In particular, our students reported in the research that a significant amount of their reflection during the DST

process was enhanced by the process of choosing imagery for use in their digital stories. Many noted that during the production process, they were constantly thinking about the kinds of images they might use in their DST, which caused continuing reflection on the incident. The choice of images also clarified and distilled emotions and the affective aspects of reflection for many of the students. Images portraying metaphors and the use of implicit imagery gave students greater insight into their own motivations and rationales in their practice choices.

Alongside a mature intervention in the local teacher education programme and robust and reusable digital storytelling resources (e.g. rubrics, timetables, software, etc.), our research has also developed a refined R-NEST model, which can be adopted and adapted by other educational designers and technologists interested to deploy narrative multimedia to enhance teachers' reflective practice. Following Ciolfi and Bannon (2003), we refer to our R-NEST model as a set of *design sensitivities*, and informants, which means they are neither exhaustive, nor prescriptive. The model must be adapted for different educational contexts, in line with the exigencies and imperatives of those settings, and their inherent distinctiveness and diversity.

Supporting design informants and resources

| Students' Perspective | Wider ITE Context | ITE Programme Perspective | Collaboration of Teacher Educators | External Evaluation |

R-NEST Design Criteria and Sensitivities

REFLECTION:
- Focuses on a single incident from practice
- Uses second order reflection as the basis for the digital story
- Allows students time to reflect at the beginning of the DST process
- Both DST process and product are important

NARRATIVE:
- Encourages personal narrative format needed in reflective writing
- Provides basic story structure information before beginning the DST process
- Utilises narrative graphic organisers such as story maps and story boards
- A time parameter or limit can enhance the final digital story

ENGAGEMENT:
- Engages students in the reflective process through novel digital media
- Makes explicit the value of the reflective and ICT skills to be gained for teaching
- Implements DST project promptly after first teaching practice experience
- Compacts production period as much as possible within the parameters of the ITE programme
- Breaks the DST process into smaller, manageable steps

SOCIALITY:
- Includes opportunities for collaborative reflection in the DST process
- Follows a formal, structured story sharing session for the story circle
- Provides tutor feedback early in the construction of the digital story
- Provides an opportunity for students to share their completed digital stories
- Scaffolds technology lessons to minimise students' anxiety or fear of using new hardware/software

TECHNOLOGY:
- Uses low-threshold technologies for the creation of DSTs
- Provides access to good quality hardware for the voiceover recording process
- Gives students a choice of recording technologies
- Provides technology support to avoid disengagement due to technological difficulties
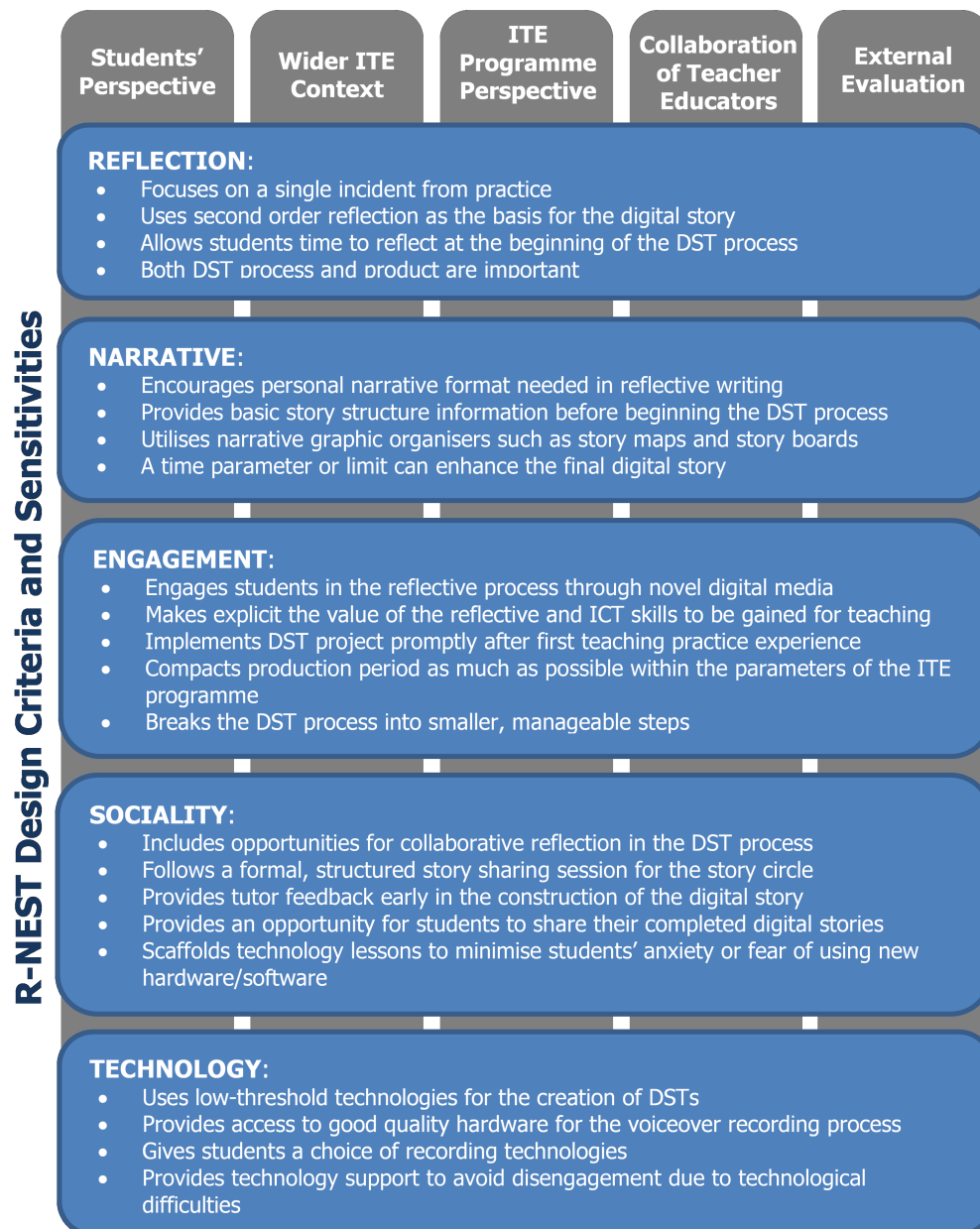
Figure 7 R-NEST design model.

We have focused in this paper on our learning across the pilot and mainstream cycles of the R-NEST design, which is now in its eighth-year of deployment. The third design cycle corroborated overall the R-NEST process, and the design work undertaken across the pilot and first mainstreaming of the DST innovation.

Our students largely found that the DST process enabled them to reflect more deeply than they had done in other reflective assignments. Reasons students gave for this deeper level of reflection were: the additional time taken to reflect while creating the DST; the self-questioning required during the process; having a chance to assess their own actions more thoroughly; looking at the incident along different time frames and from different perspectives; assessing personal beliefs and philosophies; connecting theory to practice; and having the chance to step back and see the broader context. Our students felt all of this was amplified and enhanced significantly by the use of narrative and multimedia in the creation of their DSTs.

As well as supporting our students to envision and action alternative knowledge about their teaching practice, design-based research supported us significantly as educational technologists seeking to make visible and actionable – in our own practice – innovative knowledge about narrative and technology. Through interventional design-based research, we were able to tap into and exploit the transformative potential of digital storytelling, and do so collaboratively and systematically with our students.

Overwhelmingly, the DST process improved our students' confidence and self-efficacy in using ICT in the classroom. Most students were very happy with the new skills they had acquired and many students commented on the benefits of these skills for their future teaching. Several students described themselves as 'technophobes' before they started the DST project, but said that they were no longer afraid of technology after the project. Many commented that their DST experience had 'opened their eyes' to the use of ICT for teaching and learning.

This design-based interventional research explored how digital storytelling could be designed to enhance reflective practice in initial teacher education. This constitutes an important research question – both in Ireland and internationally –

because reflection is a core, foundational developmental activity in contemporary teacher education (Collin et al. 2013; Organisation for Economic Co-operation and Development 2005; The Teaching Council 2011, 2012). Furthermore, reflection is likely to become an even more important developmental component as research and practice learning, for which critical analysis and reflection are crucially important, assume a more significant and substantial focus across the 'three i's' of the teacher education continuum – initial, induction and in-service.

This research has demonstrated how technology can be used to enhance reflection and practice learning at the initial stage of teacher education. Future research could explore how DST might be used to support teacher education in the two other key strands of the 'continuum of teacher education': induction and in-service, supporting teachers as reflective practitioners throughout their professional careers as educators.

The research reported in this paper explored a particular 'genre' of digital story, as defined by the Centre for Digital Storytelling in Berkeley, California. Considering the importance and adaptability of the multimedia design of this research, future research could explore other forms of narrative technology – where storytelling and digital media are combined in other alternative and novel ways – and examine the potential impact of these innovations on learning and reflection.

Finally, a number of our students have explored using digital storytelling to support their classroom teaching. For example, having completed her reflective digital story for the teacher education programme, one of the students in the 2011-2012 cohort used digital storytelling to teach poetry during her school placement experience. This pre-service teacher worked with her pupils in collaboratively developing a multimedia poem, inspired by and using the same narrative structure and technology as her

reflective DST. This classroom innovation further signifies the narrative potential of digital storytelling technology.

The DBR study reported here has established the potential of DST as a narrative technology-mediated reflective process. Ensuing research could look at its potential as a pedagogical-teaching methodology. This would further widen the impact of digital storytelling as an augmented narrative tool for making visible and actionable alternative knowledge in education, both in Ireland and internationally.

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