Phygital Augmentations for Enhancing History Teaching and Learning at School

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Contested Memories: The Battle of Mount Street Bridge (BMSB), funded by the Andrew W. Mellon Foundation as part of the Humanities Virtual World Consortium, is an online and annotated digital reconstruction in Unity 3D of a seminal battle of the Irish Easter Rising of 1916. A goal of the project was to leverage phenomenologies of time and space as afforded by virtual world technologies to provide new insights and help to answer what had heretofore been intractable questions about how the battle unfolded. The battle, as well as the 3D reconstruction, received a great deal of attention during the Centenary of the Easter Rising, including the specially commissioned radio documentary (Documentary on One, RTE Radio 1) *Battle at the Bridge*.

Building on the interest in and success of this project, the project team was encouraged to further develop the project so that it could be used in secondary schools. Due to the exigencies of technology in Irish classrooms, including limitations on booking lab time with many computers too old to run the VR software, it was decided that a different approach would be taken. Hence the BMSB Augmented Reality mobile app was developed (figure 1), to educate students about the facts of the battle, while providing a deeper and more holistic understanding of war and its effects. At the same time, it provided the project team with the opportunity to leverage digital humanities research within a participatory engagement setting to reach out to second level students and teachers to provide them with opportunities of engaging with cutting edge technologies integrated into a student-led learning environment.

This project shares a philosophic approach with other maker projects in the Digital Humanities, as Sayers et al. (2016), quoting Neil Gershenfield, describe in *A New Companion to Digital Humanities* as "the programmability of the digital worlds we've invented" applied "to the physical world we inhabit" in which objects "move easily, back and forth, in the space between bits and atoms." Thus Augmented Reality (AR), a technology that superimposes digital content, including images, animations, and annotations, over the real world, was decided on as the key technology to translate our research into a classroom setting. Previous research on the affordances of AR for teaching and learning have highlighted that interactivity, collaboration, problem-solving, and narratives mediated through technology can aid both engagement and understanding (Dunleavy et al., 2009). Several AR applications have been developed for primary and secondary education for fact-based topics, such as geometry, astronomy, chemistry, and the human body (see for example Chromville Science; Anatomy 4D; Elements 4D. However, AR applications for humanities subjects are limited. To the authors' knowledge there is no history-based AR application that is designed for use in the classroom, although there are several mobile-based student-centred AR for outdoor historic sites (see for example: Schrier, 2005 for the Battle of Lexington and Singh et al., 2014 for the Christiansburg Institute).

Figure 1. Early prototype of the BMSB Augmented Reality app

These kinds of technologically-driven blended-learning applications which improve digital literacy are seen as the key to the future of education, not only in Ireland, but abroad (see the Digital Strategy for Irish Schools, 2015-2020). Their employment might help to solve challenges such as personalised learning, keeping education relevant, and blending formal and informal processes (Johnson et al., 2016). This project also resonates with the call for a change in history instruction; from one that promotes passive consumption of facts to that which makes more use of analogue and digital primary sources to foster historical thinking (Tally and Goldenberg, 2005; Lee et al., 2006; Stripling, 2011), teaches historical reasoning (van Drie and van Boxtel, 2007), and provides the opportunity to problematise different sources, evaluate arguments, and form new interpretations (Borton and Levstik, 2004).

In terms of app design, the project team were aware of the challenge of how technologies have shifted our attention from the physical to the digital space: interactions with devices absorb attention, distracting from physical experiences and social interaction (Chrysanthi et al., 2012). Therefore, a premise of the project is that, if digital technologies are to assume an active role in history teaching and learning, ways to actively engage students by creating conditions that blend the physical and the digital through participatory and hands-on engagements need to be employed (figure 2).

Figure 2. Physical Materials used in 'Lesson 1 - Group 1: The Buildings

The BMSB AR app (developed for Android tablets using the Wikitude Software Development Kit for Android Studio) employs a phygital approach by enabling a task-based digital and AR exploration triggered by physical objects and primary sources, including photographs, witness statements, 3D printed buildings, and state records (figures 2, 3). Since these have a central role in the lessons, students have to evaluate their content, origins, authority, and reliability and finally through group work to form their own interpretations.
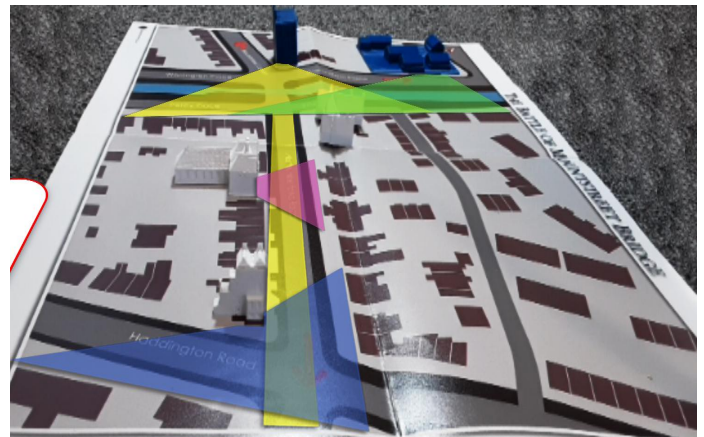

Figure 3. AR element of the app showing over the physical map the lines of fire from the four buildings that were occupied by the Irish volunteers

This project followed an iterative design methodology. The first two focus groups were carried out with second level history teachers (figure 4) to ascertain a) logistical information about schools (e.g. wireless, class size, classroom arrangement, labs etc.), and b)

how to develop content and design interactions in order students to get the most out of this experience. The results of the focus group made it clear that due to the wide variance in technology in schools across Ireland, the project had to follow the paradigm of handling/ activity boxes in museums (Comer, 2014) in which everything the teacher needs would be posted, including the tablets, physical materials, and lesson plans for a period of two weeks.

Figure 4 Second Level history teachers testing the AR app during a focus group in August 2016

This paper will report on the different stages of development of the AR app, the difficulties encountered as well as strengths of the approach. It will also describe the results of the testing and formal evaluations carried out with secondary school students and the next stages for the release of the prototype across Ireland.

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