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An emerging challenge for the Australian higher education sector is the delivery of authentic eLearning to support the collaborative construction of knowledge through the provision of real-life tasks in an online environment. This paper describes research conducted in a fourth-year university course where students from across the nation were required to work in small groups to complete an online assignment task: to design a provocation that could be integrated into an early childhood learning environment to promote multiliteracies learning. A qualitative design-based study of two cohorts of students found that online group work facilitates authentic connections between educational theory and practice, and that the introduction of a 'digital handshake' group contract can support these processes.

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Introduction

The social, educational and commercial interaction of humankind is changing due to new technologies and an acceptance that these tools can communicate information conveniently and expediently (United Nations Educational, Scientific and Cultural Organization 2009). An emerging challenge for the Australian higher-education sector is the delivery of eLearning, which uses these technologies through a learning-management system (LMS) that facilitates the collaborative construction of knowledge through engagement with authentic tasks. In the field of education, a pedagogy of multiliteracies (New London Group 1996) is a major theoretical development that can guide the collaborative construction of knowledge to achieve different sorts of learning. It also invites educators to reflect critically on how different curricular, pedagogical and classroom designs accommodate student cultural and linguistic diversity, and how these designs can use 21st-century modes of communication (Cope & Kalantzis 2000). The social constructivist educational principles embedded in a pedagogy of multiliteracies have potential to engender an enthusiasm for learning, develop critical thinking and foster productive independent and collective learning for a diverse student population in higher education (Goodling 2014; Hung & Chen 2001).

This paper examines the implementation of an eLearning innovation through the lens of a pedagogy of multiliteracies. The innovation, a "digital handshake" group contract, was introduced in a new university unit to guide students' interactions while they completed an online group assignment. The broad aim of the assignment was to facilitate meaningful connections between educational theory and practice for students who were studying Australian early childhood learning environments. More specifically, students were required to create an environmentally sustainable "provocation" suitable for an early-years learning environment: A provocation (which can take many forms) is so named because it provokes thought, discussions, questions, debate, interest, creativity and ideas. Provocations can facilitate learning processes that include constructivism, social constructivism, discovery learning and multiliteracies. A provocation that is environmentally sustainable will promote resource conservation and provoke ideas of how to live, work and play sustainably (Young & Elliot 2006). The university students were exposed to the very learning processes they were promoting for young children, yet in a higher-education environment (Johnston 2013).

The *digital-handshake group contract* (DHGC), designed by the author, was implemented in the second iteration of the unit (2013) to address equity issues that the students from the previous year (2012) had identified as an impediment to

group learning. The capabilities the innovation offers – what Salmon (2013) might call an "e-tivity" – enhances our ability as educators to understand students' meaning-making practices and how higher-education learning is extended (Magolda 2009) and applied to new contexts (Kumagai, López-Sánchez & Wu 2015). Research on this eLearning innovation contributes to an improved understanding of how to facilitate student collaboration in an online tertiary-education environment. It also examines how particular features of the design-based research (DBR) methodology were employed to respond to the challenges that emerged throughout student online group work during the first and the second iterations of the unit offering (2012 and 2013).

Before proceeding to the discussion of the DBR project, it is important that the reader is familiar with the eLearning mechanisms relevant to this study: online group work and the DHGC. Following the literature review, the research findings are examined to show the integral relationship between these educative processes as enacted in an Australian higher-education context.

Background: Australian higher education and a pedagogy of multiliteracies

The Australian higher-education sector recognises that embracing learning technology as it evolves is essential to giving students world-class, cutting-edge educational experiences that will let them work in (and shape) a diverse, complex and rapidly changing world (for examples of intent, see University of Newcastle 2014; University of South Australia 2015). At an administrative and managerial level, blueprints for providing such learning environments include a strategies approach to the allocation of resources and deployment of new information and communication technologies (ICT) systems and applications. At the teaching level, "socio-technological dynamism" (Mahmood & Singh 2003) has the potential to both harness social and cultural creativity and advance the exchange, development and application of knowledge between students and teaching staff.

Research on socio-technological dynamism is associated with extending educational opportunities; cultural and linguistic diversity are identified as integral to this dynamic force (Mani & Romijn 2004). A pedagogy of multiliteracies views language as "revisionary, creative, personal and pluralistic in nature" (Loveless, DeVoogd & Bohlin 2001, p.74). It facilitates students' use of various resources and multimodal means (visual, aural, gestural, spatial and linguistic) to communicate lived experiences and to share new understanding (Iver & Luke 2010). Furthermore, a pedagogy of multiliteracies promotes a social and culturally responsive curriculum (Jewitt 2008; Kress 2010). It can transform

teaching-learning processes (Goodling 2014) so that all Australians can become successful learners and confident and creative individuals (Ministerial Council on Education, Employment, Training and Youth Affairs 2008).

eLearning

To fuel new forms of Australian higher-education teaching and learning models and equip students for future learning, unit coordinators now trial learning-technology initiatives and respond to new opportunities, with an emphasis on collaboration and creativity. An instructional approach that reflects a social constructivist understanding of how students learn and involves the integration of real-life experiences in eLearning tasks (Cisco 2010; Hung & Chen 2001) can also facilitate the development of university graduate attributes, including:

- problem-solving and decision-making;
- creative and critical thinking;
- collaboration, communication and negotiation;
- intellectual curiosity; and
- the ability to find, select, structure and evaluate information.

Reality-based problem-solving coupled with virtual communities of practice provide students with opportunities to participate in "authentic" tasks: "activities which parallel real-life practices with multiple solutions, require collaboration and support from a variety of sources and resources, and are multidisciplinary" (Leppisaari, Kleimola, Herrington, Maunula & Hohenthal 2014, p.215). In this research project, an online group assignment posed a problem for members to solve: a shared enterprise requiring independent research (individuality) and collective eLearning (community) (Andrew, 2014).

To guide teaching and learning in the eLearning environment (including groups working on authentic tasks), Salmon (2000) proposes a five-stage model that includes access to functional technologies and motivation; socialisation; information exchange; knowledge construction; and development – which includes reflection on the learning process (skills and content knowledge).

Though the design and implementation of eLearning innovation may be spurred along by political and economic forces, as evident in the higher-education sector (Bichsel 2013; Dziuban & Picciano 2015), its sustainability ultimately depends on social considerations: its alignment with teacher pedagogy and its perceived potential to facilitate student learning. Whitworth (2012) observes that every innovation is shaped "first by the micro-level context from which it emerges and

then within other organizational and social spaces it encounters as it is developed and disseminated" (p.145). Engaging collaborative methods such as social media can foster communications and interactions that create new synergy among learners, tasks and technology, and gain the most benefit from eLearning innovation in higher education in authentic ways (Herrington, Reeves & Oliver 2006). In addition, students may generate their own context for learning; "innovations in e-learning must, therefore, be studied not only on their technical characteristics but their social ones" (Whitworth 2012, p. 146).

Whitworth (2012) poses questions to ascertain the authenticity of an eLearning innovation:

1. What were the motivations for introducing the innovation?
2. What objectives did the stakeholders seek to fulfill?
3. What organisational factors permitted the innovation to be generated, developed, implemented, evaluated, diffused and sustained?
4. What factors promoted its use (worked in its favour)?
5. What retarded the adoption of the innovation?

The criteria by which higher-education administrators, managers and teachers judge eLearning innovation as a success or failure involve personal perceptions. These perceptions will determine the innovation's future design features.

Online group work

Higher-education students undertaking group work are exposed to active-learning processes. Primary groups –with a small and definable membership – can have a collective perception of unity, a sense of shared purpose and interdependence and the ability to act in a unitary manner (Adair 2009) that is both effective and efficient. O'Sullivan, Rice, Rogerson and Saunders (1996) observe that members of a cohesive group can experience a high degree of satisfaction when they can set their pace of work and negotiate rules and practices; group work can boost productivity. Research confirms that when students draw on their "shared repertoire" (Wenger 2006) of multiliteracies and use their ICT interests and expertise, they are motivated to share information and construct meaningful messages that help others (Pirbhai-Illich 2010).

Despite the educational benefits of group work, the group-work environment is inherently challenging (Burdett 2003). Groups are not always cohesive, and members do not necessarily pool their resources of knowledge. Allocating time to socialise and form a cohesive team is identified as particularly challenging

(Becker 2003). Particularly where group members are geographically, socially and economically diverse, there is usually little opportunity for socialisation (Alexander, 2006; Devlin, Kift, Nelson, Smith, & Mackay 2012). Consequently, individual students' motivation may suffer and team commitment languish (Kear 2011). Many higher-education students cite lack of cooperation, lack of work equity and the need to depend on others as major factors in disliking group work (Morrison, 2012). Further complicating the use of group work is that external students have the highest risk for withdrawal from studies of any student group (Lake 1999; Wimshurst & Wortley 2004; Edwards & McMillan 2015). Student detachment and a lack of responsibility to group members remains an ongoing challenge for coordinators. Conversely, research reveals that when students are compelled to collaborate online (e.g. in group projects), they report more positive responses (Alkhalaf, Nguyen, Nguyen & Drew 2011). As higher education expands, an important area for development is the provision of flexible online communication tools to allow a wide range of connectivity and presentation options (Allen & Coleman, 2011).

To further facilitate a positive online experience, Australian universities have developed policies on internet use. Network etiquette – netiquette – is a set of behaviour and rules of common courtesy for interaction with people online; for example, not sending heated messages (referred to as "flames") even if provoked, and remembering that the online recipient is a human being whose culture, language and humour may have different points of reference than those of the sender. Online niceties, however, neither ensure the development of a community of learners (Conrad 2002; Brook & Oliver 2003) nor guarantee the individual learner's commitment to completing an online task (Goold, Craig & Coldwell 2008).

Thus, while a required online group task may give initial impetus to group cohesion (when students begin to interact with one another and with the coordinator on an LMS), this research project showed that the development of the DHGC was required to instill a sense of obligation among all students to fully participate in the completion of an online group task. The innovation provided a framework for facilitating "e-tivities" in an asynchronously online environment within a context of performativity (Andrew 2014; Salmon 2013).

The digital-handshake group contract

A contract can facilitate the negotiation of students' individualised learning pursuits within the group context. It can also build upon "core capacities which should be developed and reflected in our education institutions" (Bruns & Humphreys 2007, p. 2). While contracts to motivate student ownership of learning

are not new to the educational environment, the DHGC was designed not only to support more-equitable online collaboration between students but also to increase students' understanding of the capabilities of new technologies. The contract (Table 1) stipulated that group members should participate in specific processes. Members were required:

- to provide an explanation of the purpose of the online group work and how it helped achieve the stated learning objectives of the unit;
- to establish explicit procedures, roles and responsibilities for each member; and
- to formulate mechanisms for gauging the contributions of individuals to the online group project.

Table 1. The digital-handshake group contract

The Digital-Handshake Group Contract
[each group member is to complete and forward their signed contract to the coordinator]

Group Number:

Conditions

I agree to:

- Abide by the terms of this contract in relation to the group assessment for EDxxx.
- Participate in a fair manner and to an equal degree with my group members in respect of each stage of the assessment as set out in the [unit] *Information and Learning Guide*.
- Undertake the specific tasks set out next to my name below.
- Undertake the specific tasks according to a group-determined timeline.
- Communicate with group members via LMS on a weekly basis to provide an update of my work-in-progress.
- Keep an accurate record of my written contribution to the assessment, which must be produced to the coordinator within 48 hours of a request by email.
- Keep a back-up copy of the work done towards this assessment.
- Treat fellow members of the group with respect as specified in the *University Student Code of Conduct*.

I understand that:

- If I fail to meet my obligations as detailed in this Group Assessment Contract then I have failed to meet the assessment requirements for EDxxx.

SIGNED by: .....

Print Name: .....

Student Number: .....

My assigned tasks include:
a) …
b) etc.

Notes:
1. Students may add additional terms as their specific circumstances require and as agreed by all members of the group.
2. This contract must be attached to your assignment coversheet.

The contract required a mutual obligation between the group members to abide by the unit guidelines while completing the assignment. It also provided opportunities to assume collective responsibility to complete the group assignment. The utility of the contract was not determined by a legal form; rather, it stemmed from creating a sense of obligation among group members – a duty that one owes – within a trust situation (Faulkner 2014). Palloff and Pratt (2000) found that students do not automatically gravitate to a learning-community approach. The development of a social "presence", however, can positively affect student learning and satisfaction.

Research context

In 2012, a new university unit, Early Childhood Learning Environments, was offered for students enrolled in the Early Childhood Studies program. It was imperative that these students became familiar with the Commonwealth Government's mandated National Quality Framework (Australian Children's Education and Care Quality Authority 2011) to raise quality and ensure continuous improvement of Australian early-childhood learning environments. The unit was offered in external mode only (to students residing across the nation). A key ethical consideration in "any study, Internet-based or otherwise" is that "participants ought to be given enough information to judge whether or not they wish to participate" (Nosek, Banaji & Greenwald 2002, p.162). Disclosure and the authenticity of this DBR were established when participants were advised that the research aimed to improve further offerings of the online group assignment. This qualitative inquiry reduced power differences by inviting participants to consent to this research project after the unit marks were published. Penalties for refusing or withdrawing consent could not be imposed as participants had completed the unit; thus, there was no perceived or actual obligation for students to participate in the project. Permissions were subsequently gained and confidentiality was assured through the use of pseudonyms.

Research methodology

Since the 1990s, DBR has emerged as a paradigm that offers versatility and resourcefulness and invites a radical spirit of openness when studying rapid social change and diversification (Crotty 1998; Denzin & Lincoln 2005). DBR helps researchers understand the relationships between educational theory and practice to address theoretical questions about the nature of learning in context, and to study learning phenomena in the real world (Collins, Joseph & Bielaczyc 2004). DBR aims to employ rigorous construction and evaluation methods to create technology to meet organisational needs: "Its design is conceived not just to meet local needs, but to advance a theoretical agenda, to uncover, explore, and confirm theoretical relationships" (Barab & Squire 2004, p. 5). As Wang and Hannafin (2006, p.6) explain:

> [DBR researchers] assume the functions of both designers and researchers, drawing on procedures and methods from both fields, in the form of a hybrid methodology. Researchers manage the process with participants, design and implement interventions systematically to refine and improve initial designs, and ultimately advance both pragmatic and theoretical aims affecting practice.

A key feature of DBR is the practical action that results from it (Cole, Purao, Rossi & Sein 2008). The broad aims of this DBR were twofold: to support students in participating in group work equitably and contributing equally towards a shared assignment mark; and to foster a sense of obligation in an online environment among people who are not friends, who will only meet online and who, in all likelihood, will never work together after the unit. More specifically, the research question that guided this investigation was: Can the introduction of a digital handshake facilitate the group cohesiveness required to ensure confident information exchange and mutual development of an online assignment?

Methods of data generation (2012 and 2013) that facilitated this investigation included reflections on the research coordinator's role, discussions with academic colleagues and a review of LMS transcripts and students' assignment products. Formative student feedback on the innovation was provided to the coordinator when students asked clarifying questions and discussed unit content in LMS forums during the semester. Summative, end-of-semester online student surveys, though potentially fraught with validity issues, were also reviewed at the end of both teaching periods (2012 and 2013) to determine the extent to which the group assignment had helped students achieve the unit learning objectives:

1. Initiate discussion about the scope and purpose of the early-childhood learning environment;
2. Provide authentic opportunities to apply theoretical understandings of how environments can be places of research; and
3. Support each other's [student] learning by providing appropriate feedback and prompting critical and creative thinking about ideas and issues.

Data was analysed according to Miles, Huberman and Saldana's (2014) recommended process of data reduction, data display and data conclusion and verification. During the second unit offering (2013), intended solutions were trialed (as contained in the group contract, which mandated weekly online progress reports from the group). Following document analysis and reflective critique, a search for patterns, themes and categories was conducted. Hence, the DBR "findings emerged out of the data, through the analyst's interactions with the data" (Patton 2002, p.453). Adopting a postmodern interpretivist approach, I used "triangulation" (cross-referencing different data sources to verify the accuracy of findings) to confirm the multiple realities within which people live within a given inquiry space (Silverman 2001). Triangulation facilitated my identification of the different realities of academic colleagues, students and self (Stake 2005).

Challenges inherent to the DBR methodological framework are well documented: there "remains confusion about how to do design research"; DBR "lacks methodological rigor or clear standards"; and DBR "cannot live up to the claim of *simultaneous* design evaluation and theory building" (Sandoval 2013, p.19). In a timely review of the progress made in education research employing DBR methodology, Anderson and Sattock (2012, p.22) found that

> most DBR studies do not produce measureable effect sizes that demonstrate "what works". However, they provide rich descriptions of the contexts in which the studies occurred, the challenges of implementation, the development processes involved in creating and administrating the interventions, and the design principles that emerged.

The dual role of coordinator and researcher is also viewed as problematic. However, there is continued optimism that DBR can bridge the chasm between research and practice in formal education. The following section provides a description of the authentic tasks embedded in the design of the online group assignment.

Authentic tasks

Early in the semester (2012 and 2013), students were assigned to a small LMS discussion group for the purposes of providing one another with informal support and discussing the design of their online group assignment. Students were informed that their participation in the group assignment was a requirement to pass the unit. The group task involved designing one PowerPoint presentation, using Google Docs, to present a provocation for learning made from recycled materials that could be integrated into a real-life early-childhood learning environment. The students were advised that the task would require a high level of collaboration, so it was recommended that they contact each other early in the semester through the LMS forum.

The unit readings, visits to recycling centres/websites and observations conducted at two early-childhood learning environments (located in the student's local community) had exposed students to a range of real-life play ideas with accompanying design considerations. The PowerPoint presentation, consisting of 20 slides, would show high-quality digital images of the group's provocation in a learning environment. For example, using computing skills, students could superimpose and scale an image of the provocation onto a photograph showing its intended indoor and outdoor setting. The presentation would include reference to unit readings, such as the National Quality Framework (safety issues, maintenance, sufficient space, invites open-ended interactions, etc.). It would also deliver commentary on the relationship between environmental sustainability and learning environments relevant to the group's provocation, and would include keywords and metaphors used by Ceppi and Zini (2001) to describe quality environmental features. A summary reflection on students' personal learning while completing the assignment (i.e. related to the educational theories of constructivism, social constructivism, discovery learning and multiliteracies) would also be presented. The presentation required accompanying music and video footage. The students were able to contact a university IT specialist for support. All presentations were uploaded to the LMS at the end of the semester for other groups to review, thus expanding students' repertoire of early-childhood learning provocations.

First iteration

In 2012, 12 students enrolled in the unit and were placed at random into three groups. Three LMS discussion forums were established so that members could discuss their project collectively and so that the coordinator could monitor information exchange, knowledge construction and development. After the

students had introduced themselves on the LMS, they exchanged email addresses, and subsequently communicated with one another outside the forum. Thereafter, the coordinator could not monitor how individual group members progressed with the task. The IT specialist, however, was emailed regularly for assistance. One group asked to use Prezi (cloud-based presentation software), which proved to be more user-friendly when inserting multimodal features and allowed them to more effectively illustrate their ideas using motion, zoom and spatial relationships. This resulted in a sophisticated final product.

At the end of the semester, student survey responses (to individual Likert items) presented positive feedback on the unit, with 100% agreeing with the item statement: "Overall, I was satisfied with the quality of this [unit]". Survey comments also confirmed that "authentic" learning had occurred: "The task allowed us to communicate and learn to work with people we do not know"; and "Working together in this group situation teaches you how to be fair and how to work with others in a professional and kind way" (Student Survey Responses, 2012).

All students (100% Overall Agree on the Likert item) confirmed that the Course Information Guide clearly described the assignment task. However, students' written feedback (optional section included in the survey) indicated that group members' individual roles and responsibilities associated with completing the aims of the assignment were not clearly described. Comments focused on equity issues, such as "the group assignment was a very challenging and frustrating aspect" and "it was hard when [the Course Information Guide] stressed [that] we all receive the same mark, and some students didn't contribute although we understood how it worked". One student urged subject organisers to "change the group assignment".

The coordinator also received several emails of complaint from students regarding colleagues' hitch-hiking or hijacking within group work; that is, either not pulling their weight and still receiving a good grade due to the efforts of the other group members, or wanting to take over the assignment tasks themselves. Some students communicated their difficulty with time management and "fitting in" with other group members' proposed plans. Coghlan (2001) has described the process of managing the communication of others online as "e-moderation", which is similar to a classroom teacher managing or moderating students' face-to-face encounters. During the second iteration, the implementation of the DH assisted the course coordinator as an "e-moderator" to facilitate students shared commitment to work together toward better communication (Salmon 2000).

Second iteration

In 2013, 56 students enrolled in the unit (14 groups were formed). In response to feedback from the 12 students who completed the unit in 2012, and aiming to yield results successively closer to a more equitable group experience for students enrolled in the 2013 unit, the DHGC was designed and implemented. The contract required each student to comply with a set of conditions that stipulated specific tasks nominated by the group during a designated period. The contract, essentially an open-ended framework, was developed further by group members and then emailed to the coordinator. The contract was also signed by each student and attached to their assignment marking sheet. To assist the coordinator in monitoring group-work activities, one representative from each group (nominated by the group) was required to post a weekly report on the LMS detailing what members had achieved during the week.

It is noteworthy that while these reports provided the coordinator with general information about assignment progression, the report did not identify students' individual weekly contributions. All reports focused on the collective achievement of group goals. In addition to the DHGC intervention, the 2013 Course Information Guide stipulated that students use Prezi, which resulted in fewer technical difficulties.

Research findings

Student survey comments during the first iteration focused on group-work equity and issues related to time management and accountability. Comments in this vein included: "It is important to make everyone accountable to help out from the start to get the assignment done rather than leave a few to do most of the work" and "Although collaboration is an important skill, forcing it in an online external early-childhood unit was unnecessarily stressful in my opinion". In contrast, students participating in the second iteration commented primarily on the merits of collaborative efforts: "The [unit] objective to collaborate through IT (Assignment 3) was an exceptional strategy to include professional collaboration in this [unit] as opposed to university student-orientated collaboration".

The digital-handshake group contract

Throughout the second iteration (after the introduction of the DHGC), student feedback towards the group assignment was more positive. In the first iteration, 81.2% of the students felt the online group task satisfied the learning objectives. This increased to 100% in the second iteration. These students were communicative: sharing ideas, updating one another on their progress and seeking

or offering advice, support and feedback through the LMS. One student stated: "Although we had our own roles and responsibilities, a sense of 'group' tied these elements together" (Student Reflection 2013). Cultural and linguistic diversity associated with socio-technological dynamism and a pedagogy of multiliteracies was accommodated within each group when delegating and performing individual roles and responsibilities to the satisfaction of all group members. Examples of authentic tasks that students identified as involving problem-solving and decision-making included:

- Working out how to establish Google Docs (and troubleshooting issues related to poor network connectivity and configuring or verifying Google Drive settings etc.).
- Completing one weekly update on assignment progress to be uploaded to the LMS.
- Undertaking visits to an early-years learning environment and taking photos of play provocations to get ideas to share.
- Completing research and writing information linking the provocation to NQS Quality Area 3: physical environment.
- Researching the relationships between environmental sustainability and learning environments.
- Designing a specified number of slides on a sub-topic.
- Relating environmental sustainability to the provocation.
- Organising and collecting all the information/photographs/music needed.
- Completing personal reflections so that the input could be approved by the rest of the group.
- Completing a summary reflection on personal learning.
- Proofreading and finalising the final product.
- Assisting the group in any other ways perceived necessary.

Importantly, all groups in the second iteration created a schedule of tasks in the DHGC that they believed was achievable given members' other life commitments.

Responses to LMS forum

In the first iteration, the students' preference was for the group to communicate outside the LMS forum using email and Facebook, and where possible to meet face-to-face in a social context to discuss the group assignment. This preference continued throughout the second iteration despite the introduction of readings that identified a range of communication tools that could be used: the LMS discussion forum; instant messaging; Web 2.0 tools outside the platform (i.e. Skype, personal blogs); and the telephone.

Once it had become a mandatory requirement of the unit, the weekly online progress reported detailed group activities and provided a level of accountability for and between students and the coordinator; students knew the coordinator would read the text dialogue and provide weekly feedback on their progress. This formative feedback among students also guided the steady progression of scheduled tasks. Members used the LMS to communicate personal satisfaction with the assignment product, affirming and praising one another's efforts. An example of this was: "Hi ladies, the Prezi looks fabulous! Very happy with how it has all come together and I'm sure it will look even better with the finishing touches" (Student LMS Entry, 2013). The LMS forum also served as a social medium where students shared personal experiences (illness, holiday, marriage/engagement, moving house etc.) and updated one another on how they were juggling other commitments with their contracted tasks.

Authentic connections between educational theory and practice

In both iterations, students made strong connections between the educational theory presented in the unit readings and real-life experiences to demonstrate relevant application in early-childhood learning environments. The group experience assisted students' understanding of educational processes involving constructivism, social constructivism, discovery learning and multiliteracies on a personal level (Figures 1 and 2). The group reflections presented in Figures 1 and 2 show that students made connections with the importance of practical hands-on experiences and using recycled materials to provide purposeful provocations in early-learning environments. Students also made meaningful connections to their lived experiences of social constructivism in terms of having – or not having – actual spoken dialogue and physical interaction with group members while completing the assignment. There was acknowledgement that to bring their provocation to life they needed to use the knowledge and skills embodied in their multiliteracies. While this was challenging, students recognised that people learn in different ways – an important consideration when working with children in an early-learning environment.

Figures 1 & 2. Student reflections linking educational theory with practice

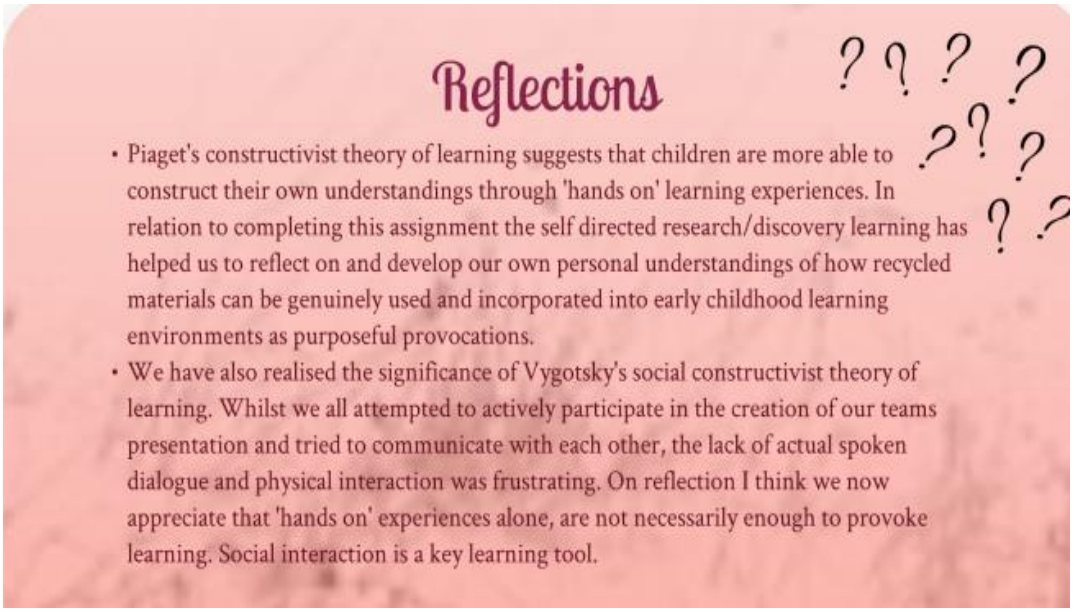
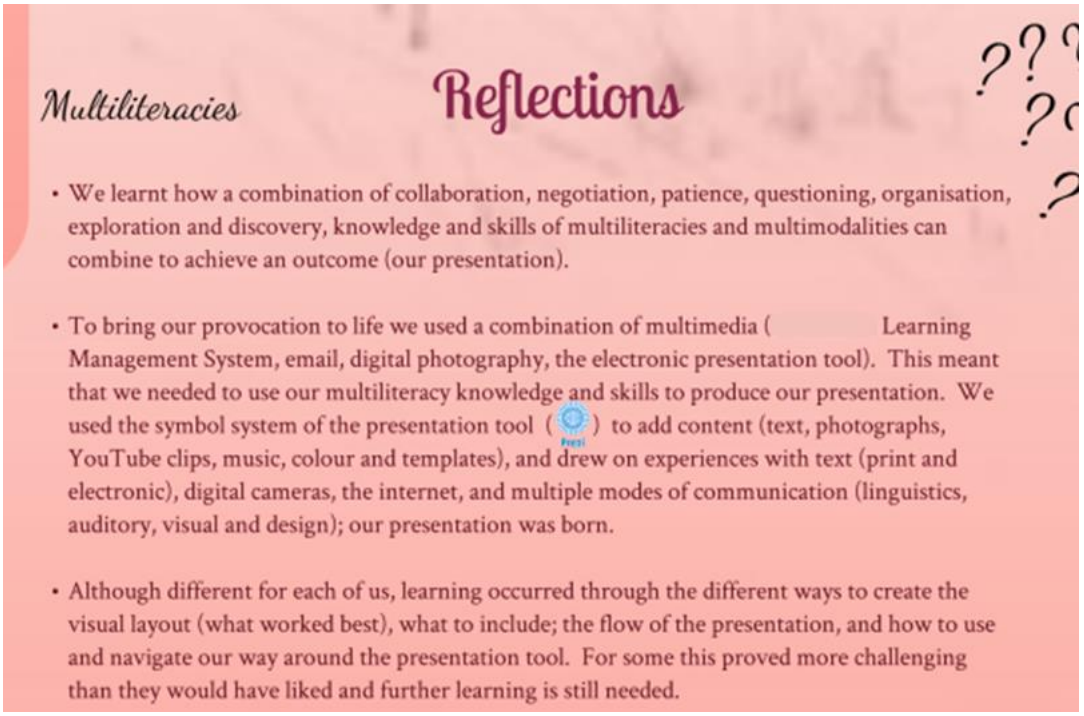


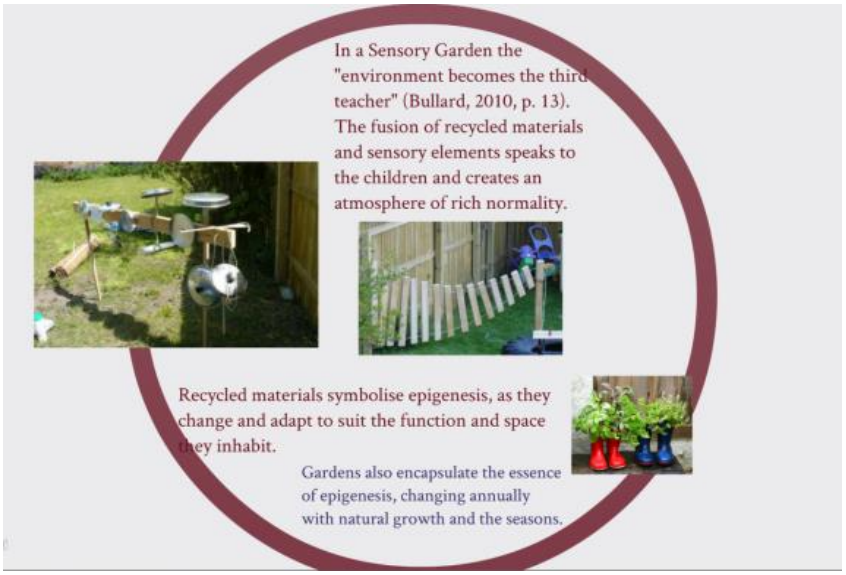
Figure 2



The information in Figures 3 and 4 further demonstrates the capabilities offered by the innovation. Students' understanding of the unit readings was transferred to meaning-making practices and applied to a new context. Commentary on the relationship between environmental sustainability and learning environments includes keywords and metaphors used by Ceppi and Zini (2001) to describe quality environmental features. Sustainable provocations invite open-ended interactions.

Figures 3 & 4. Provocations integrated in an early-childhood environment

Figure 3



Discussion

This study investigated how a higher-education eLearning environment can provide an
authentic group task. The task sparked students' intellectual curiosity and developed their ability to find, select, structure and evaluate information (Cisco 2010) relevant to an early-childhood learning environment. The task involved complex activities – activities students had not encountered previously and found challenging to complete. In this case, the eLearning environment (LMS and social media) forged authentic connections between early-childhood educational theory and practice (Figures 1 through 4).

Students participating in the first iteration commented that while the online assignment had presented challenges, the group experience had provided authentic opportunities (Leppisaari et al. 2014) to collaborate, communicate, negotiate, compromise, delegate, problem-solve and acquire new skills and knowledge essential for teaching in the early-childhood learning environment. There was an awareness that the multiliteracies used to compile and present the assignment were authentic and aligned with young children's lived experiences in a contemporary multimodal world (Bullard 2010). The online learning environment, however, proved to be an inequitable and frustrating experience.

The introduction of the DHGC in 2013 further supported the functionality of group-work eLearning processes, as shown in the PowerPoint student reflections. The exchange of ideas, options, knowledge and skills (Salmon 2000) as students worked together toward a common goal was more frequent, and was facilitated by the DHGC requirement of online weekly reports. Students agreed that the collaborative construction of knowledge enabled "greater learning" than if they had completed the assignment on their own. During the second iteration, while this was not a unit requirement, some groups elected to construct a real-life rather than a virtual provocation to be used in an early-years learning environment that they had visited during unit fieldwork. This was a rewarding experience for these students, who – spurred by intellectual curiosity to design a provocation – were provoked to extend their group's creative and critical thinking:

> We were fortunate to be able to set up our provocation in a real-life [early years learning] centre…. I felt proud and happy…. This was a valuable experience for me to see how children would engage and explore with our provocation…this collaborative, hands-on experience extended my own creativity
> (Student Reflection, 2013).

The eLearning innovation was driven by the coordinator's experimentation with providing a group provocation in the form of an online assignment. During both iterations, "the big picture" perspective of facilitating connections between educational theory and practice was the key motivational driver. However, solving problems and keeping abreast of the students' needs occurred simultaneously at the micro-management level (Whitworth 2012). The content and structure of the DHGC as an intervention was first considered after the analysis and exploration phase of the first iteration. This data was then used to create a series of design principles to guide the second iteration that reduced complaints related to inequality in student participation (despite a fourfold increase in student enrolments). The strength of the contract was confirmed and its function as a solution to a real-life problem was validated.

Cotton, Lockyer and Brickell (2009) note, "Design-Based Research knowledge is gained in the form of design principles" (p. 1365). The design principles of the DHGC were not the sole outcome of the DBR process: my understanding of how to better support students' collaborative construction of knowledge in an online environment also deepened (Hung & Chen 2001). The DBR project aims were achieved: students participated in group work equitably and contributed equally towards a shared assignment mark; and an enforced obligation was instilled among students who had been unknown to one another prior to the commencement of the unit. This investigation confirmed that the introduction of a "digital handshake" can facilitate group cohesiveness in higher education, as evidenced by the independent exchange of information and the shared success of completing an online assignment that students deemed challenging (Goodling 2014).

The limitations of this study were: first, that the student sample size reviewed in both the first and second iteration was small; and second, that despite the introduction of a group contract, collective effort "rests with the will of the individual" (Brook & Oliver 2011, p.43). In spite of the fact that the contract reduced the number of student-reported incidences reported of colleagues "hitch-hiking" or "hijacking" group work and addressed equity issues related to student effort and commitment, there were still cases where individual students did not complete the tasks specified in the group contract due to unforeseen circumstances. These students required an individualised learning contract to complete the assignment, and their withdrawal from the group impeded their colleagues' progress. These particular cases continue to present a challenge to the coordinator, suggesting that the DHGC requires further refinement.

Conclusion

This paper has examined the implementation of an eLearning innovation designed to facilitate authentic connections between educational theory and practice for higher-education students in the Early Childhood Studies program. The instructional approach enabled students from a diverse population to experience constructivism, social constructivism, discovery learning and multiliteracies learning processes at a personal level. Though not within the scope of this study, a noteworthy finding was that many students willingly shared personal information in the LMS space. These exchanges were not to satisfy university netiquette *per se* but were used as an accountability measure – to explain to others how competing interests affected the time available to complete assignment tasks. These communications perhaps provide evidence that students had developed a sense of obligation to justify their inaction.

Above all, the design-based research project generated a widely usable authentic artefact (Collins et al. 2004) – a digital-handshake group contract – that can provide educational knowledge for authentic eLearning praxis. The DHGC design satisfied Whitworth's (2012) criteria for eLearning innovation status, and its implementation aligned with Salmon's (2000) five-stage model to guide teaching and learning in an eLearning environment. Significant to this research project were the higher-education organisational factors that permitted this innovation to be generated, developed, implemented, evaluated, diffused and sustained (Whitworth 2012). These included the social constructivist principles embedded in a pedagogy of multiliteracies that accommodated cultural and linguistic diversity; the freedom afforded to the coordinator by the university to experiment with an eLearning innovation; ready access to on-the-spot IT support when the students needed it; and the mandatory signed group contract that supported socio-technological dynamism. Conditions that retarded the adoption of the innovation were students' competing life interests and their failure to access available IT support in a timely manner. Clearly, the advances in technology are accompanied by inherent characteristics of innovation, diversity and socio-technological dynamism: characteristics that create new and yet-to-be-explored possibilities for higher education.

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